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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61F 13/15 — A1

(11) International Publication Number: WO 00/02511

(43) International Publication Date: 20 January 2000 (20.01.00)

(21) International Application Number: PCT/US99/15442

(22) International Filing Date: 8 July 1999 (08.07.99)

(30) Priority Data:
60/092,399 10 July 1998 (10.07.98) US
09/185,895 4 November 1998 (04.11.98) US

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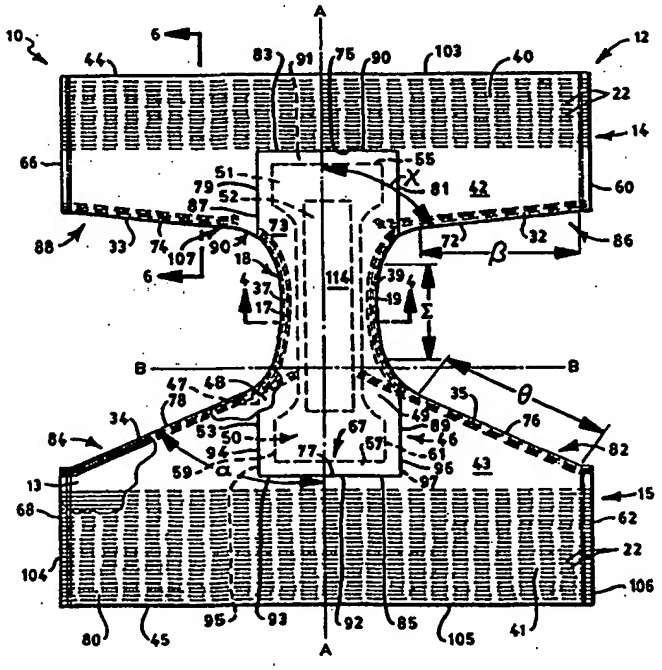
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: DISPOSABLE UNDERPANTS INCLUDING SKEWED ABSORBENT CORE

(57) Abstract

A three dimensional disposable underpant having an absorbent core has been skewed forward by a factor of no more than 0.155. The absorbent core is disposed within the front, central, and back sections of the disposable underpant such that the length of the absorbent core in the back section of the disposable underpant divided by the length of the absorbent core in the front and central sections of the disposable underpant is less than 0.155 and the length of the absorbent core in the front section of the disposable underpant is greater than the length of the absorbent core in the back section of the disposable underpant. The disposable underpant may include elasticized leg and waist openings, resulting in the underpant being stretchable about the hip and stomach regions of a user.



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DISPOSABLE UNDERPANTS INCLUDING SKEWED ABSORBENT CORE

Field of the Invention

This present invention relates to underpants in general, and more specifically to disposable incontinence underpants having a liquid impervious region and an absorbent core shifted forward for more effectively containing and absorbing body discharges and waste.

Background of the Invention

Various types of garments, or combinations of absorbent articles and garments are presently used to provide an underpant-type garment for absorbing human discharge. Examples of such garments include regular (non-disposable) underpants, regular underpants used in combination with various incontinence or absorbent articles, and disposable absorbent undergarments have the basic structure including an aqueous liquid pervious topsheet layer, and absorbent core containing one or more layers for receiving and absorbing the discharge, and an aqueous liquid impervious liquid barrier for containing the discharge.

Disposable underpant-type garments, as is well known, now find widespread use for adult incontinence care, as well as for infant care. (However, due to the differences between small children and adult bodies as well as the different activities and movements of small children and adults, simply increasing the size of disposable training pants to adult sizes may not meet many of the needs of adult users.) The typical disposable underpant-type garment is a three-layer composite structure comprising a liquid permeable bodyside inner liner (topsheet layer), a liquid impermeable outer cover (liquid barrier) and an absorbent batt sandwiched between the liner and the cover. The absorbent batt is typically symmetrically placed between the front waist band and the back waist band. Materials now in general use for the three principal elements of the disposable underpant-type garment include various types of nonwoven fabrics for the bodyside liner (topsheet layer), a thin thermoplastic film for the outer cover (liquid barrier)

and cellulosic fluff for the absorbent batt.

While some of these garments perform satisfactorily for their intended purpose, there remains the need to provide a more discrete underpant-type garment that possesses improved absorption characteristics, improved utilization of the absorbent material, as well as improved waste containment characteristics with a minimum of discomfort to the wearer. More specifically, heretofore, underpant-type garments have not been designed to facilitate the transfer of aqueous liquids to the entire area, including the distal ends, of the absorbent layer or layers of the absorbent core. As a result, waste absorption is concentrated in a small region of the absorbent core which results in an under utilization of much of the absorbent capacity of the underpant-type garment.

Underpant-type garments and most other absorbent personal care garment-like products are typically worn in a "J" configuration. The front region of the underpant-type garment is worn lower on the wearer's body than the back region of the underpant-type garment. As such, the center of the underpant-type garment typically does not coincide with the point of insult. The point of insult occurs toward the front region of the underpant-type garment. The present underpant-type garments do not adequately provide absorbent material at the point of insult. In addition, underpant-type garments having absorbent cores that include centrally located acquisition zones do not provide the expected absorbency, resulting in product failure.

Heretofore, some underpant-type garments for absorbing and containing human discharge have typically been bulky and somewhat ineffective. Typically, the absorbent core is placed such that much of the absorbent capacity is located where it is not totally utilized and creates a configuration which is bulky, particularly in the center portion and back region. Obviously, this style of underpant-type garment is uncomfortable to wear, especially if the wearer is an active adult. In addition, this form of underpant-type garment results in the costly and inefficient placement of absorbent material in the back region where it is not used and hence wasted.

Thus, it becomes apparent that a need exists for an absorbent underpant-type garment that improves the absorbent characteristics and the containment characteristics of the underpant-type garment while still being comfortable to wear.

Summary Of The Invention

Briefly, this invention describes a three dimensional, disposable, discrete underpant which typically includes elasticized leg openings and waist portion that is circumferentially stretchable about the hip and stomach regions and which provides incontinence protection.

The protection benefit is obtained by providing a flexible absorbent core associated with the crotch area of the underpant wherein the absorbent core is maintained in proper location for incontinence discharge by an elastic system surrounding each leg opening. The absorbent core extends from the crotch area of the underpant into the body of the underpant in front and back body portions. This provides an underpant which is capable of trapping and absorbing the incontinence discharge and preventing liquid strike through onto outer clothing and bed linen.

The present invention provides an improved absorbent disposable underpant having improved absorption and containment characteristics as well as improved comfort characteristics. The disposable underpant of the invention provides an absorbent core disposed primarily in the front section and the central section such that the absorbent core is not placed symmetrically in the longitudinal dimension of the disposable underpant which facilitates the formation of an adequate and comfortable disposable underpant when formed from a generally flat to an anatomically-conforming condition.

In addition, the proportion (skew factor) of the absorbent core length in the back section divided by the combined absorbent core length of the central section plus the front section of the disposable underpant should be less than about 0.270. The disposable underpant also provides an elasticized design that facilitates the formation of a pouch structure in the central section, as well as an effective seal between the disposable underpant and the wearer, whereby the disposable underpant is comfortable to wear and has improved containment characteristics.

The present preferred embodiment of the invention also provides an absorbent

core that facilitates rapid aqueous liquid transfer in the x, y , and z directions by having a generally continuous and constant proportion of fiber and superabsorbent in the CD and MD directions throughout the dimensions of the absorbent core. However, the absorbent core may have varying densities and zones of fiber or superabsorbent in the CD and MD direction throughout the dimensions of the absorbent core.

In addition, the disposable underpant may further include a surge layer (intake material) to contain large aqueous liquid gushes between the topsheet layer and the absorbent core, or a pledget between the absorbent core and the liquid barrier. In some embodiments, the disposable underpant may include both a pledget and a surge layer (intake material). Ideally the pledget and surge layer (intake material) should be skewed into the front and central sections of the disposable underpant and need not be present in the back section.

Further objects of the present invention will appear in the description hereinafter.

DEFINITIONS

Aqueous liquid impervious describes a layer or laminate means that aqueous liquid such as urine will not pass through the layer or laminate under ordinary use conditions in a direction generally perpendicular to the plane of the layer or laminate at the point of aqueous liquid contact.

Back, back side, or back portion with reference to the human anatomy are defined by reference to Fig. 1 Fig. 3 illustrates a transverse axis or plane passing through the center of the illustrated undergarment to divide it into a front half and a back half. The "back" or "back side" or "back portion" of the wearer will include that portion from the centerline on one side of the wearer and around the back to a similar point on the other side of the wearer.

Back Section is the back one third of the total garment length which is worn on the

posterior side of the wearer's body.

Barrier fabric or **barrier** means a fabric which is relatively impervious to the transmission of aqueous liquids, i.e., a fabric which has blood strikethrough rate of 1.0 or less according to ASTM test method 22.

OR, **barrier fabric** refers to a fabric having a useful level of resistance to penetration by aqueous liquid and/or particulates. General speaking, resistance to aqueous liquid penetration is measured by hydrostatic head tests, strike-through tests, water spray penetration tests and the like. Unless otherwise specified, a material with resistance to aqueous liquid penetration refers to a material having a hydrostatic head of at least about 20 centimeters as determined in accordance with the standard hydrostatic pressure test AATCCTM No. 127-1977. For example, such a aqueous liquid resistant material may have a hydrostatic head of 60 centimeters or more. Resistance to penetration by particulates may be measured by determining the air filter retention of dry particles and can be expressed as a particles holdout efficiency. In particular, particle hold-out efficiency refers to the efficiency of a material at preventing the passage of particles of a certain size range through the material. Particle holdout efficiency may be measured by determining the air filter retention of dry particles utilizing tests such as, for example, IBR Test Method No. E-217, Revision G (Jan. 15, 1991) performed by InterBasic Resources, Inc. of Grass Lake, Mich. General speaking, a high particle holdout efficiency is desirable for barrier fabrics. Desirably, barrier fabrics should resist penetration by a column of tap water of at least about 20 cm and/or should have a particle hold-out efficiency of at least about 40 percent for particles having a diameter greater than about 0.1 micron.

Blend means a mixture of two or more polymers while the term "alloy" means a sub-class of blends wherein the components are immiscible but have been compatibilized. "Miscibility" and "immiscibility" are defined as blends having negative and positive values, respectively, for the free energy of mixing. Further, "compatibilization" is defined as the process of modifying the interfacial properties of an immiscible polymer blend in order to make an alloy.

Bonded refers to the joining, adhering, connecting, attaching, or the like, of two elements. Two elements will be considered to be bonded together when they are bonded directly to one another or indirectly to one another, such as when each is directly bonded to intermediate elements.

Bonded carded web refers webs are made from staple fibers which are sent through a combing or carding unit, which breaks apart and aligns the staple fibers in the machine direction to form a generally machine direction-oriented fibrous nonwoven web. Such fibers are usually purchased in bales which are placed in a picker which separates the fibers prior to the carding unit. Once the web is formed, it then is bonded by one or more of several known bonding methods. One such bonding method is powder bonding, wherein a powdered adhesive is distributed through the web and then activated, usually by heating the web and adhesive with hot air. Another suitable bonding method is pattern bonding, wherein heated calender rolls or ultrasonic bonding equipment are used to bond the fibers together, usually in a localized bond pattern, though the web can be bonded across its entire surface if so desired. Another suitable and well-known bonding method, particularly when using bicomponent staple fibers, is through-air bonding.

Bulk refers to the thickness of samples measured with a Model 49-70 thickness tester available from TMI (Testing Machines Incorporated) of Amityville, N.Y. The thickness tester was equipped with a 2-inch diameter circular foot and measurements were taken at an applied pressure of about 0.2 pounds per square inch (psi). Bulk measurements of samples that are substantially dry (i.e., having a moisture content generally less than about 10 percent, by weight, as determined by conventional methods) may be referred to as dry bulk.

CD direction means the cross or short direction of the product.

Cellulosic fibers refers to fibers comprising cellulose, a linear, water-wettable polysaccharide, whether existing as a single constituent in a larger natural aggregate such as wood pulp, bagasse and cotton linters, or as a derivative of the natural aggregate such as alpha pulp or viscose rayon.

Central Section means the central one third of the total garment length which is between the front and back sections of the product on the wearer's body.

Closely adjacent means one element is positioned as close to another element as can be feasibly accomplished due to other nearby structure, manufacturing restraints, comfort or fit considerations, or the like.

Coform means a process in which at least one meltblown diehead is arranged near a chute through which other materials are added to the web while it is forming. Such other materials may be pulp, superabsorbent particles, cellulose or staple fibers, for example. Coform processes are shown in commonly assigned US Patents 4,818,464 to Lau and 4,100,324 to Anderson et al. Webs produced by the coform process are generally referred to as coform materials.

Consisting essentially of does not exclude the presence of additional materials which do not significantly affect the desired characteristics of a given composition or product. Exemplary materials of this sort would include, without limitation, pigments, antioxidants, stabilizers, surfactants, waxes, flow promoters, particulates and materials added to enhance processability of the composition.

Continuous means that the described structure is a closed-loop structure. The continuous structure may be unitary, i.e., a one-piece structure, or may be made up of individual elements suitably joined together to form a closed-loop.

Disposable means that the described garment or article is designed to be used until soiled, either by urination, defecation, or otherwise, and then discarded, rather than being washed and reused again;

OR **disposable** is not limited to single use or limited use articles but also refers to articles that are so inexpensive to the consumer that they can be discarded if they become soiled or otherwise unusable after only one or a few uses.

Disposed, disposed on, disposed with, disposed at, disposed near, or variations thereof, are intended to mean that one element can be integral or unitary with another element, or that one element can be a separate structure joined to or connected to or placed with or placed near another element.

Elastic or **elastomeric** when referring to a fiber, film or fabric mean a material which upon application of a biasing force, is stretchable to a stretched, biased length which is at least about 150 percent, or one and a half times, its relaxed, unstretched length, and which will recover at least 50 percent of its elongation upon release of the stretching, biasing force.

Elasticity, elastic, or **elasticized** refers to that property of a material or composite elastic material that permits it to recover at least a portion of its original size and shape after removal of the force causing the deformation (expressed in %).

Elasticizable describes a temporarily inhibited elasticized or elastic member that can be activated to recover its elasticity.

Elasticized means that a material that is naturally non-elastic is rendered elastic by suitably joining it to an elastic material.

Elongation means the ratio of the extension of a material to the length of the material prior to the extension (expressed as a percent), as represented by the following: extended length - original length / original length x 100.

Extensible, Elongatable, or variations thereof mean that the material can have its length increased (expressed in units of length). See also **Stretch**.

Extension, Extend, Extended, or variations thereof refers to an increased change in length of a material due to stretching, and is expressed in units of length.

Fabric is used to refer to all of the woven, knitted, and nonwoven webs.

Filament refers to an element having a high ratio of length to diameter or width, and may comprise a fiber, thread, strand, yarn or the like or combination of these elements.

Finished product means a product that has been suitably manufactured for its intended purpose.

Flexible refers to materials that are compliant and readily conform to the general shape and contours of the human's body.

Front, Front side, or **Front portion** include the front part of the article or garment complementary to the above-defined **Back, Back side,** or **Back portion.**

Front or **Back** are used throughout this description to designate relationships relative to the garment itself, rather than to suggest any position the garment assumes when it is positioned on a wearer.

Front Section is the forward one third of the total garment length which is worn on the anterior side of the wearer's body.

Fully gathered with reference to, for example, an opening or border means that the material about the opening or border is gathered along its total periphery.

Garment means any type of non-medically oriented apparel which may be worn. This includes industrial work wear and coveralls, undergarments, pants, shirts, jackets, gloves, socks, and the like;

OR, **garment** means any type of apparel which may be worn. This includes industrial work wear and coveralls, undergarments, pants, shirts, jackets, gloves, socks, and the like.

Hydrophilic describes fibers or surfaces of fibers that are wetted by the aqueous liquids in contact with the fibers. The degree of wetting of the materials can be described in terms of contact angles and the surface tensions of the liquids and materials involved. Equipment and techniques suitable for measuring the wettability of

particular fiber materials or blends of fiber materials can be provided by a Cahn SFA-222 Surface Force Analyzer System. When measured with this system, fibers having contact angles less than 90° are designated "wettable", i.e., "hydrophilic", and fibers having contact angles greater than 90° are "nonwettable", i.e., "hydrophobic".

Intake layer or **intake material** refers to a material designed to help decelerate and diffuse surges of aqueous liquid that are introduced to the absorbent pad. Examples of surge materials are described in U.S. Patent 5,192,606 issued March 9, 1993, to D. Proxmire et al.; U.S. Patent 5,486,166 issued January 23, 1996 to Ellis et al.; U.S. Patent 5,490,846 issued February 13, 1996 to Ellis et al.; and U.S. Patent 5,509,915 issued April 23, 1996 to Hanson et al.; the disclosures of which are hereby incorporated by reference. Also referred to as **surge layer**.

Integral refers to various portions of a single unitary element rather than separate structures bonded to or placed with or placed near one another.

Inward or **outward** refer to positions relative to the center of an absorbent garment, and particularly transversely and/or longitudinally closer to or away from the longitudinal and transverse center of the absorbent garment.

Joining, Join, Joined, or variations thereof, when used in describing the relationship between two or more elements, means that the elements can be connected together in any suitable manner, such as by heat sealing, ultrasonic bonding, thermal bonding, adhesives, stitching, or the like. Further, the elements can be joined directly together, or may have one or more elements interposed between them, all of which are connected together.

Layer when used in the singular can have the dual meaning of a single element or a plurality of elements.

Liquid means a substance and/or material that flows and will assume the interior shape of a container into which it is poured or placed. For this specification, it means an aqueous material.

Liquid communication or **liquid migration** refer to the ability of an aqueous liquid to travel through or between (or along) two structures in the absence of an aqueous liquid impervious barrier preventing aqueous liquid travel between (or along) the two structures.

Liquid impervious when used in describing a layer or laminate including at least one aqueous liquid impervious film or layer and at least one aqueous liquid pervious film or layer means that the aqueous liquid will not pass through the laminate, under ordinary use conditions, in a direction generally perpendicular to the plane of the laminate at the point of aqueous liquid contact. Liquid may spread or be transported parallel to the plane of the aqueous liquid impervious film or layer, but this is not considered to be within the meaning of "aqueous liquid impervious" when used with reference to the laminate.

OR, describe the laminate as a 2- or 3-layer laminate comprising a "aqueous liquid impervious film" and a "aqueous liquid pervious layer". This avoids describing the "laminate" as aqueous liquid impervious, and relies on the aqueous liquid impervious film for its impervious feature. Note that aqueous liquid can wick/spread in the nonwoven layer and then possible over the top/distal end of the film which makes the laminate aqueous liquid "pervious" unless you use the description above.

Machine direction or **MD** means the length of a fabric in the direction in which it is produced. The term "cross machine direction" or CD means the width of fabric, i.e. a direction generally perpendicular to the MD.

MD Direction is the longitudinal long direction of the product and is typically the direction in which the product is manufactured.

Member when used in the singular can have the dual meaning of a single element or a plurality of elements.

Microfibers means small diameter fibers having an average diameter not greater than

about 75 microns, for example, having an average diameter of from about 0.5 microns to about 50 microns, or more particularly, microfibers may have an average diameter of from about 2 microns to about 40 microns. Another frequently used expression of fiber diameter is denier, which is defined as grams per 9000 meters of a fiber and may be calculated as fiber diameter in microns squared, multiplied by the density in grams/cc, multiplied by 0.00707. A lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. For example, the diameter of a polypropylene fiber given as 15 microns may be converted to denier by squaring, multiplying the result by .89 g/cc and multiplying by .00707. Thus, a 15 micron polypropylene fiber has a denier of about 1.42 ($15^2 \times 0.89 \times .00707 = 1.415$). Outside the United States the unit of measurement is more commonly the "tex", which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9.

Monocomponent fiber refers to a fiber formed from one or more extruders using only one polymer. This is not meant to exclude fibers formed from one polymer to which small amounts of additives have been added for coloration, anti-static properties, lubrication, hydrophilicity, etc. These additives, e.g. titanium dioxide for coloration, are generally present in an amount less than 5 weight percent and more typically about 2 weight percent.

Multilayer laminate means a laminate wherein some of the layers are spunbond and some meltblown such as a spunbond/meltblown/spunbond (SMS) laminate and others as disclosed in U.S. Patent 4,041,203 to Brock et al., U.S. Patent 5,169,706 to Collier, et al, US Patent 5,145,727 to Potts et al., US Patent 5,178,931 to Perkins et al. and U.S. Patent 5,188,885 to Timmons et al. Such a laminate may be made by sequentially depositing onto a moving forming belt first a spunbond fabric layer, then a meltblown fabric layer and last another spunbond layer and then bonding the laminate in a manner described below. Alternatively, the fabric layers may be made individually, collected in rolls, and combined in a separate bonding step. Such fabrics usually have a basis weight of from about 0.1 to 12 osy (6 to 400 gsm), or more particularly from about 0.75 to about 3 osy. Multilayer laminates may also have various numbers of meltblown layers or multiple spunbond layers in many different configurations and may include other materials like films (F) or coform

materials, e.g. SMMS, SM, SFS, etc.

Non-elastic refers to any material that does not fall within the definition of "elastic".

Nonwoven fabric or **nonwoven web** means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes such as for example, meltblowing processes, spunbonding processes, and bonded carded web processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91).

Nonwoven web means a web of material which is formed without the aid of a textile weaving or knitting process.

OR, means a web having a structure of individual fibers or threads that are interlaid, but not in any identifiable, repeating pattern. Nonwoven webs have been, in the past, formed by a variety of processes such as, for example, meltblowing processes, spunbonding processes, and bonded carded web processes.

OR, means a web of material which is formed without the aid of a textile weaving or knitting process. Nonwoven webs have been formed from many processes such as for example, meltblowing processes, spunbonding processes, and bonded carded web processes. The basis weight or nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns.

Operatively joined, **Elastically associated**, or **Associated with** with reference to the attachment of an elastic member to another element means that the elastic member when attached to or placed with or formed from the element gives that element elastic properties. With reference to the attachment of a non-elastic member to another element, it means that the member and element can be

attached or placed together in any suitable manner that allows or permits them to perform their intended or described function, while not completely inhibiting the properties of the individual elements. The attaching or placing can be either directly, such as attaching or placing either member directly with an element, or can be indirectly by means of another member or element disposed between the first member and the first element. OR, describes the joining of an elastic member to a non-elastic member such that the two joined members exhibit elasticity or elastic properties.

OR **operatively joined**, with reference to the attachment of an elastic member to another element, means that the elastic member when attached to or connected to the element, or treated with heat or chemicals, by stretching, or the like, gives the element elastic properties; and with reference to the attachment of a non-elastic member to another element, means that the member and element can be attached in any suitable manner that permits or allows them to perform the intended or described function of the joinder. The joining, attaching, connecting or the like can be either directly, such as joining either member directly to an element, or can be indirectly by means of another member disposed between the first member and the first element.

Outward refers to a position relative to the center of an absorbent garment, and particularly transversely and/or longitudinally away from the longitudinal and transverse center of the absorbent.

Partially elastic refers to a substrate, garment, a part of a garment, or the like, having at least one portion thereof that is elastic.

Particles as in SAP or SAM means any geometric or non-geometric form such as, but not limited to, spherical grains, cylindrical fibers or strands, flat surfaces or roughened surfaces, sheets, ribbons, strings, strands, or the like. When used in an absorbent structure, the particles can be loosely formed into a shaped structure or compressed into a shaped form.

Permeable or **permeability** (also **Pervious**) refer to the ability of a aqueous liquid, such

as, for example, a gas to pass through a particular porous material. Permeability may be expressed in units of volume per unit time per unit area, for example, cubic feet per minute) per square foot of material (e.g., ft^3/minute/ft^2). Permeability was determined utilizing a Frazier Air Permeability Tester available from the Frazier Precision Instrument Company and measured in accordance with Federal Test Method 5450, Standard No. 191A, except that the sample size was 8"x8" instead of 7"x7". Although permeability is generally expressed as the ability of air or other gas to pass through a permeable sheet, sufficient levels of gas permeability may correspond to levels of aqueous liquid permeability to enable the practice of the present invention. For example, a sufficient level of gas permeability may allow an adequate level of aqueous liquid to pass through a permeable sheet with or without assistance of a driving force such as, for example, an applied vacuum or applied gas pressure.

Personal care product means diapers, training pants, absorbent underpants, adult incontinence products, and feminine hygiene products;

OR, **personal care product** means diapers, training pants, absorbent underpants, adult incontinence products, and feminine hygiene products and the like.

Polymer generally includes but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecule. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

Pulp refers to pulp containing fibers from natural sources such as woody and non-woody plants. Woody plants include, for example, deciduous and coniferous trees. Non-woody plants include, for example, cotton, flax, esparto grass, milkweed, straw, jute hemp, and bagasse.

Releasably attached, releasably bonded, releasably engaged, or variations thereof refer to two elements being connected or connectable such that the elements tend

to remain connected absent a separation force applied to one or both of the elements, and the elements being capable of separation without substantial permanent deformation or rupture. The required separation force is typically beyond that encountered while wearing the absorbent garment.

Retraction or variations thereof refers to a decreasing change in length of an extended material upon removal of the force causing the extension.

Side refers to a position in which a side of the body faces the supporting surface.

Spunbonded fibers refers to small diameter fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, in US Patent 4,340,563 to Appel et al., and US Patent 3,692,618 to Dorschner et al., US Patent 3,802,817 to Matsuki et al., US Patents 3,338,992 and 3,341,394 to Kinney, US Patent 3,502,763 to Hartman, and US Patent 3,542,615 to Dobo et al. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns, more particularly, between about 10 and 20 microns.

Staple fiber refers to a natural fiber or a length cut from, for example, a manufactured filament. Staple fibers typically have a length between about 3 and about 7.5 millimeters.

Stretch, Stretchability, Stretch characteristics, or variations thereof mean that the material can have its length increased (expressed in units of length). See also **Extensible.**

Stretch bonding refers to a process wherein an elastic member is bonded to another member while only the elastic member is extended at least about 25 percent of its relaxed length. "Stretch bonded laminate" refers to a composite elastic material made according to the stretch bonding process, i.e.: the layers are joined together

when only the elastic layer is in an extended condition so that upon relaxing the layers, the nonelastic layer is gathered. Such laminates usually have machine directional stretch properties and may be stretched to the extent that the nonelastic material gathered between the bond locations allows the elastic material to elongate. One type of stretch bonded laminate is disclosed, for example, by US Patent 4,720,415 to Vander Wielen et al., in which multiple layers of the same polymer produced from multiple banks of extruders are used. Other composite elastic materials are disclosed in US Patent 4,789,699 to Kieffer et al. , US Patent 4,781,966 to Taylor and US Patents 4,657,802 and 4,652,487 to Morman and 4,655,760 to Morman et al.

Substrates, Surface, or **Sheet** means a **Layer** that may be a film or woven web or nonwoven web, a laminate; pervious or impervious to air, gas, and/or aqueous liquids; or a composite structure comprising for example a topsheet, backsheet, and an absorbent medium therebetween.

Superabsorbent refers to absorbent materials capable of absorbing at least 10 grams of aqueous liquid (e.g. distilled water per gram of absorbent material while immersed in the liquid for 4 hours and holding substantially all of the absorbed aqueous liquid while under a compression force of up to about 1.5 psi.

Surge layer refers to a material designed to help decelerate and diffuse surges of aqueous liquid that are introduced to the absorbent pad. Examples of surge materials are described in U.S. Patent 5,192,606 issued March 9, 1993, to D. Proxmire et al.; U.S. Patent 5,486,166 issued January 23, 1996 to Ellis et al.; U.S. Patent 5,490,846 issued February 13, 1996 to Ellis et al.; and U.S. Patent 5,509,915 issued April 23, 1996 to Hanson et al.; the disclosures of which are hereby incorporated by reference. It is also referred to as **intake layer** or **intake material**.

Surface includes any layer, film, woven, nonwoven, laminate, composite, or the like, whether pervious or impervious to air, gas, and/or aqueous liquids.

Tension refers to a force tending to cause the extension of a body, or to the balancing force within that body resisting the extension. Tension is expressed in units of

grams.

Thermoplastic decides a material that softens when exposed to heat and which substantially returns to a nonsoftened condition when cooled to room temperature.

Through-air bonding or **TAB** means a process of bonding a nonwoven bicomponent fiber web in which air which is sufficiently hot to melt one of the polymers of which the fibers of the web are made is forced through the web. The air velocity is between 100 and 500 feet per minute and the dwell time may be as long as 6 seconds. The melting and resolidification of the polymer provides the bonding. Through air bonding has relatively restricted variability and since through-air bonding TAB requires the melting of at least one component to accomplish bonding, it is restricted to webs with two components like conjugate fibers or those which include an adhesive. In the through-air bonder, air having a temperature above the melting temperature of one component and below the melting temperature of another component is directed from a surrounding hood, through the web, and into a perforated roller supporting the web. Alternatively, the through-air bonder may be a flat arrangement wherein the air is directed vertically downward onto the web. The operating conditions of the two configurations are similar, the primary difference being the geometry of the web during bonding. The hot air melts the lower melting polymer component and thereby forms bonds between the filaments to integrate the web.

Two-dimensional refers to a garment, such as a diaper, that can be opened and laid in a flat condition without destructively tearing any structure. This type of garment does not have continuous leg and waist openings when opened and laid flat, and requires a refastening device, such as adhesive tapes, to attach about the wearer.

Waistband refers to a border about the waist opening of an underpant, and may be constructed of one or more layers of material.

Brief Description Of The Drawings

The present invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention and the drawings, in which:

Figure 1a is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 1b is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 1c is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 2a is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 2b is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 3 is a top plan view of a disposable underpant article of the present invention in a preassembled flat configuration;

Figure 4 is a perspective view of a full-sized, disposable underpant of the present invention.

Figure 5 is a perspective view of a full-sized, disposable underpant of the present invention.

Figure 6 is a sectioned view taken along view lines 6-6 of **Figure 1a** and illustrating the outer cover, liner (topsheet layer) and elastics.

Figure 7 is a sectioned view taken along view lines 6-6 of **Figure 2b** and illustrating the outer cover, liner (topsheet layer) and elastics.

Figure 8 is an exploded sectioned view taken along view lines 4-4 of **Figure 1a** and illustrating the absorbent layer, barrier and outer cover.

Figure 9 is an exploded sectioned view taken along view lines 4-4 of **Figure 2a** and illustrating the absorbent layer, barrier and outer cover.

Figure 10 is an expanded plan view of a disposable underpant article of the present invention in a preassembled flat configuration and showing a skewed forward placement of the absorbent pad.

Figure 11 is an expanded plan view of a disposable underpant article of the present invention in a preassembled flat configuration and showing a skewed forward placement of the absorbent pad.

Figure 12 is an expanded plan view of a disposable underpant article of the present invention in a preassembled flat configuration and showing a skewed forward placement of a profile absorbent pad.

Figure 13a is a cross-sectional view of the absorbent pad taken along section line 4-4 of **Figure 1a** and showing a homogeneous distribution of fibrous and high absorbency material.

Figure 13b is a cross-sectional view of the absorbent pad taken along section line 4-4 of **Figure 1b** and showing a homogeneous distribution of fibrous and high absorbency material which has a profiled basis weight distribution.

Figure 14 is a cross-sectional view of the absorbent pad taken along section line A-A of **Figure 1a** and showing a homogeneous distribution of fibrous and high absorbency material.

Figure 15a is a cross-sectional view of the absorbent pad taken along section line 4-4 of

Figure 1a and showing a layered distribution of fibrous and high absorbency material.

Figure 15b is a cross-sectional view of the absorbent pad taken along section line A-A of **Figure 1a** and showing a pulsed distribution of fibrous and high absorbency material with little high absorbency material in the ends.

Figure 15c is a cross-sectional view of the absorbent pad taken along section line 4-4 of **Figure 1a** and showing a non-uniform distribution of fibrous and high absorbency material in the cross direction of the absorbent pad.

Detailed Description of the Preferred Embodiments

The following detailed description is made in the context of an article **10** including a disposable underpant **12** including an absorbent core in place during use. It is readily apparent, however, that the present invention can be employed for incontinence, vaginal, perspiration discharges, and the like in adult, child and infant products.

The disposable underpant **12** of **Figure 1a** illustrates the preferred embodiment of the present invention in a flat configuration prior to assembly. In **Figure 1a**, the underpant **12** is shown having an outer cover **13** which includes a front body portion **14**, a back body portion **15**, a front waist edge portion **44**, a back waist edge portion **45**, a crotch portion **18**, waist liner **26** (optional, shown in **Figures 5** and **7**), leg liner **38** (optional, shown **Figures 5** and **7**) and body liner **80**. The outer cover **13** may include a front body portion **14**, a back body portion **15**, a front waist edge portion **44**, a back waist edge portion **45**, and a crotch portion **18** wherein the crotch portion **18** is interposed between the front and back body portions **14** and **15**.

The outer cover **13** is compliant and soft feeling to the wearer. The outer cover **13** may be any soft, flexible, porous sheet which is liquid pervious, permitting liquids to readily penetrate into its thickness, or impervious, resistant to the penetration of liquids into its thickness. A suitable outer cover **13** may be manufactured from a wide range of

materials, such as natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of natural and synthetic fibers or reticulated foams and apertured plastic films.

There are a number of manufacturing techniques which may be used to manufacture the outer cover **13**. For example, the outer cover **13** may be woven or nonwoven web or sheet such as a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments, such as polypropylene, polyethylene, polyesters or the like, or a web of natural polymer filaments such as rayon or cotton. The bonded-carded web may be thermally bonded or sprayed with a binder by means well known to those skilled in the fabric art. Suitably, the outer cover **13** is a nonwoven spunbond. Ideally, the outer cover **13** is a spunbond polypropylene nonwoven with a wireweave bond pattern. Suitably, the spunbond material is available from Kimberly-Clark Corporation, located in Roswell, GA. The outer cover **13** has a weight from about 0.3 oz. per square yard (osy) to about 2.0 osy and alternatively about 0.6 osy. The outer cover **13** of the underpant maybe printed, colored or decoratively embossed. The outer cover **13** has a pore size that readily allows the passage therethrough of air, sweat, perspiration due to the breathability of the material. The outer cover **13** may be selectively embossed or perforated with discrete slits or holes extending therethrough.

Referring to **Figures 1a, 2a**, and **3**, an edge **60** of front body portion **14** is assembled with an edge **62** of the back body portion **15** to form a seal or side seam **64**. Similarly, an edge **66** of the front body portion **14** is assembled with an edge **68** of the back body portion **15** to form a seal or side seam **70**. The front body portion **14** and the back body portion **15**, when assembled form a waist opening **20** for putting on and taking off the underpant **12**. The waist opening **20** is surrounded at least in part by waist portion elastic **22** including from between 1 and 40 elastic strands, threads, ribbons, or bands of elastic material. The waist portion elastic **22** is stretched and attached to the body portions **14** and **15**. The waist portion elastic **22** may also be placed in the front and back waist edge portions **44** and **45**. (In other embodiments, the waist portion elastic **22** may be contained only in the front body portion **14** or only in the back body portion **15**). The waist portion elastic **22** are released after attachment to produce waist portion folds, gathers, or pleats **24** (shown in **Figures 4** and **5**) to allow expansion of the waist opening

20 and the body portions 14 and 15 so that the underpant 12 can fit various sized individuals.

Because users of this invention generally prefer a brief style underpant, the front waist edge portion 44 of the underpant 12 preferably comes to the navel and even around the wearer's waist. Having the underpant 12 at this height and then drawing in either or both front and back body portions 14 and 15 with the waist portion elastic 22 provides a snug fit. Alternative underpant styles may include bikini (e.g. regular leg cut and french leg cut) and hipster (e.g. regular leg cut or french leg cut).

In some embodiments, the waist opening 20 is surrounded by waist elastic 21 including at between 1 and 10 strands, ribbons, or bands of elastic materials that are stretched and attached to the front waist edge portion 44 and/or the back waist edge portion 45. (See Figures 5 and 7.) (In other embodiments, the waist elastic 21 may be contained only in the front waist edge portion 44 or in the back waist edge portion 45.) The waist elastic 21 is released after attachment to produce waist folds, gathers, or pleats 25 to allow expansion of the waist opening 20 so that the underpant 12 can fit various sized individuals. Using waist elastic 21 having a different tension or elongation than the tension or elongation used in the waist portion elastic 22 can provide a better fitting underpant 12.

Referring again to Figure 1a, the front body portion 14 and the back body portion 15 together with the crotch portion 18 forms leg openings 28 and 30, respectively, which are generally circular or oval in shape. The leg openings 28 and 30 are each surrounded at least in part by leg elastics 32, 33, 34, and 35, respectively. The front leg elastics 32 and 33 are stretched and attached to the front body portion 14, back leg elastics 34 and 35 are stretched and attached to the back body portion 15 and the crotch elastics 37 and 39 are stretched and attached to the crotch portion 18. The leg and crotch elastics 32, 33, 34, 35, 37, and 39 are released after attachment to produce leg gathers (also referred to as folds or pleats) 36 to allow expansion of the leg openings 28 and 30 to fit various sized legs.

The front body portion 14 is usually divided into a front upper body portion 40 and a

front lower body portion **42**. (See **Figures 1a, 2a,** and **3.**) Similarly, the back body portion **15** is divided into a back upper body portion **41** and a back lower body portion **43**. The front and back upper body portions **40** and **41** are preferably designed to include waist portion elastic **22** which is capable of stretching to allow the wearer to put on the underpant **12** and then readily contracting and conforming to the wearer's body. This ensures a close or snug fit to different body shapes and sizes. The waist portion elastic **22** is positioned on both the front and the back upper body portions **40** and **41**, respectively, at positions between the waist opening **20** and the leg openings **28** and **30**, so that the underpant **12** fits the wearer better, particularly around the body. The front and back lower body portions **42** and **43** do not necessarily require waist portion elastic **22**. The basis weight of the laminate comprising the outer cover **13**, the body liner **80**, and waist portion elastic **22** may be as high as 5 osy.

The crotch portion **18** of the underpant **12** consists of an absorbent barrier composite **46**. The absorbent barrier composite **46** may and generally does extend into the front body portion **14** and/or the back body portion **15**. (See **Figure 1a.**) The absorbent barrier composite **46** further consists of a liquid barrier **48**, a substantially liquid pervious topsheet layer **49**, and an absorbent core **50** sandwiched between the liquid barrier **48** and the topsheet layer **49**. The liquid barrier **48** and the topsheet layer **49** are desirably longer and wider than the absorbent core **50**, so that the peripheries of the liquid barrier **48** and the topsheet layer **49** form margins which may be sealed together using ultrasonic bonds, thermal bonds, adhesives, or other suitable means. In this sealed area, the crotch elastics **37** and **39** may be incorporated between the liquid barrier **48** and the topsheet layer **49**. The absorbent core **50** may be attached to the liquid barrier **48** and/or the topsheet layer **49** using ultrasonic bonds, adhesives, or other suitable means. (See **Figures 1a, 8,** and **9.**)

The absorbent barrier composite **46** may also include additional components to assist in the acquisition, distribution, and storage of body exudates. For example, the absorbent barrier composite **46** may include a transport layer, such as described in U.S. Patent 4,798,603 issued January 17, 1989, to Meyer et al., or a surge management layer, such as described in European Patent Application EP 0 539 703 A1, published May 5, 1993, which patent and application are incorporated herein by reference. Such layers are also referred to as acquisition/distribution layers.

The absorbent barrier composite **46** can be constructed by supplying topsheet layer **49** and liquid barrier **48** materials and sandwiching an individual absorbent core **50** between the liquid barrier **48** and the topsheet layer **49**. The side and end peripheries of the liquid barrier **48** and the topsheet layer **49** outward of the absorbent core **50** can be joined with the crotch portion **18**, the front body portion **14**, and the back body portion **15** and sealed together. The absorbent barrier composite **46** and/or the absorbent core **50** may optionally be T-shaped, I-shaped, oval-shaped, hourglass-shaped, rectangular-shaped, or irregularly-shaped. In addition, the absorbent barrier composite **46** and/or absorbent core **50** may also include leg cutouts **29** and **31** opposing indentations in the longitudinal sides **87** and **89** of the absorbent barrier composite **46**, the longitudinal side edges **59** and **61** of the absorbent core **50** and/or the longitudinal side edges **104** and **106** of the disposable underpant **12**. Leg cutouts **29** and **31** may improve the fit of the disposable underpant **12** as the reduced bulk between the wearer's legs reduces or prevents gapping, thereby preventing leaks as well as improving comfort. The other materials used in the disposable underpant **12**, including but not limited to the topsheet layer **49**, the liquid barrier **48**, and outer cover **13** may also be shaped to include leg cutouts **29** and **31**. However, in some embodiments, it may be desirable for the absorbent core **50** to be shaped to include leg cutouts **29** and **31**, and not shape the other materials, including the topsheet layer **49**, the liquid barrier **48**, and the outer cover **13**, to include leg cutouts **29** and **31**. In the absorbent barrier composite **46** and/or absorbent core **50**, leg cutouts **29** and **31** are not typically placed symmetrically in disposable underpant **12** but are skewed toward the front end edge **103** of the disposable underpant **12**.

Throughout the specification, the term "generally rectangular" is used by the applicants. However, it is not intended that this term be limited to only a rectangular shape. But, instead, this term can include geometric shapes that are rectangular, oval or racetrack patterns, hourglass configurations, bilobal shapes, and in general any shape where the length is greater or less than the width.

Referring to **Figures 1a, 1b, 1c, 2a, 2b, 3, 10, 11,** and **12**, the absorbent core **50** is of a generally rectangular shape and includes a peripheral edge **67** comprised of side edges **59** and **61**, a front end edge **55**, and a back end edge **57**. The absorbent core **50** has an exterior surface **63** that faces away from the wearer, and an interior surface **65**

that faces towards the wearer.

The porous fibrous matrix of absorbent core **50** is preferably an air laid batt of fluff and high absorbency material which may be formed in many ways, for example according to the teaching of Mazurak and Fries as set forth in U.S. Patent 4,381,782 the entire disclosure of which is incorporated herein by reference. Referring to **Figures 13a, 13b, 14, 15a, 15b,** and **15c**, the absorbent core **50** can comprise an air-formed mixture of high absorbency material (SAP) **110** and fibers **112**, preferably of fluff pulp. Most preferably, as shown in **Figures 13a, 13b,** and **14**, the mixing of the fluff fibers **112** and the high absorbency material **110** is homogeneous. In other embodiments, as shown in **Figures 15a, 15b,** and **15c**, the mixtures can be layered (**Figure 15a**), phased to place the high absorbency material in a specific machine direction location (**Figure 15b**), or placed in a narrow band in the cross direction (**Figure 15c**). Also, fibers other than fluff pulp such as chemically stiffened and thermomechanical pulps can be used. In addition, the absorbent core **50** can comprise absorbent material other than air formed fluff and SAP. For example, coform materials as referenced in US Patents 4,818,464 to Lau and 4,100,324 to Anderson can be used to make the absorbent as long as they also contain high absorbency materials. In addition, wet formed composite materials comprising a combination of fibers and high absorbency materials as disclosed in US Patent 5,651,862 to Anderson et. al. can also be used. Stabilized airlaid materials comprising a mixtures of fibers, binder fibers, and high absorbency materials which are bound together by latex binding or through air bonding are also usable as absorbent materials.

The hydrogel polymers are desirably sufficiently cross-linked to render the materials substantially water-insoluble. Cross-linking may, for example, be by irradiation or by covalent, ionic, van der Waals or hydrogen bonding. Suitable materials are available from various commercial vendors, such as Dow Chemical Company (Drytech 2035 LD), Hoechst-Celanese Corporation and Allied-Colloid. Typically, the high-absorbency material is capable of absorbing at least about 15 times its weight in water, and desirably is capable of absorbing more than about 25 times its weight in water.

The high-absorbency material can be distributed or otherwise incorporated into the absorbent core **50** employing various techniques. For example, as illustrated in **Figures 13a, 13b, 14, 15a, 15b,** and **15c**, the high-absorbency material can be substantially

uniformly distributed among the fibers comprising the absorbent core **50**. The materials can also be non-uniformly distributed within the absorbent core **50** fibers to form a generally continuous gradient with either an increasing or decreasing concentration of high-absorbency material, as determined by observing the concentration moving inward from the liquid barrier **48**. Alternatively, the high-absorbency material can comprise a discrete layer separate from the fibrous material of the absorbent core **50**, or can comprise a discrete layer integral with the absorbent core **50**.

The absorbent pad **50** may also include a wrap layer **100** to help maintain the integrity of the fibrous core. (See **Figure 8**.) This wrap layer **100** may comprise a cellulosic tissue or spunbond, meltblown or bonded-carded web material composed of synthetic polymer filaments, such as polypropylene, polyethylene, polyesters or the like or natural polymer filaments such as rayon or cotton.

The absorbent core **50** should have an aqueous liquid capacity great enough to absorb discharges from about 10 grams to about 1500 grams. The absorbent core **50** should preferably have a capacity (described below) and a thickness preferably less than about 25 mm, thus providing a non-bulky and flexible fit. The capacity of the absorbent core **50** should have a total capacity of about 200 grams to about 1300 grams. Preferably, the absorbent core **50** should have a total capacity of at least about 300 grams and not more than about 1200 grams. More preferably, the total capacity of the absorbent core **50** should be from about 400 grams to about 800 grams.

The total capacity of the absorbent core **50** is determined using the absorbent barrier composite **46** of the underpant **12**, and the outer cover **13**. The saturated retention capacity is a measure of the total absorbent capacity of an absorbent article **10**, in this case, a disposable underpant **12**. The saturated retention capacity is determined as follows. The disposable underpant **12** to be tested, having a moisture content of less than about 7 weight percent, is then weighed and submerged in an excess quantity of the room temperature (about 23° C) saline solution described below. The material is allowed to remain submerged for 20 minutes. After 20 minutes the disposable underpant **12** is removed from the saline solution and placed on a Teflon ™ coated fiberglass screen having 0.25 inch openings (commercially available from Taconic Plastics Inc., Petersburg, N.Y.) which, in turn, is placed on a vacuum box and covered with a flexible rubber dam

material. A vacuum of 3.5 kilopascals (0.5 pounds per square inch) is drawn in the vacuum box for a period of 5 minutes. The disposable underpant **12** is weighed. The amount of aqueous liquid retained by the material being tested is determined by subtracting the dry weight of the disposable underpant **12** from the wet weight of the disposable underpant **12** (after application of the vacuum) and is reported as the saturated retention capacity in grams of aqueous liquid retained.

The saline solution is an aqueous solution of about 0.9 percent sodium chloride by weight. A suitable product is S/P™ Certified Blood Saline commercially available from Baxter Diagnostics in McGaw Park, Illinois.

The absorbent core **50** comprises materials adapted to absorb and retain urine, menses, blood, or other body excrement. The absorbent core **50** may comprise various natural or synthetic absorbent materials, such as cellulose fibers, surfactant treated meltblown fibers, wood pulp fibers, regenerated cellulose or cotton fibers, a blend of pulp and other fiber, or the like. One such material is a coform material which is composed of a mixture of cellulosic fibers and synthetic polymer fibers. The absorbent core **50** may also include compounds to increase its absorbency, such as 0 - 95 weight percent of organic or inorganic high-absorbency materials, which are typically capable of absorbing at least about 15 and desirably more that 25 times their weight in water.

Organic high-absorbency materials can include natural materials, such as pectin, guar gum and peat moss, as well as synthetic materials, such as synthetic hydrogel polymers. Such hydrogel polymers may include, for example, carboxymethylcellulose, alkali metal salts of polyacrylic acids, polyacrylamides, polyvinyl alcohol, ethylene maleic anhydride copolymers, polyvinyl ethers, hydroxypropyl cellulose, polyvinyl morpholinone, polymers and copolymers of vinyl sulfonic acid, polyacrylates, polyacrylamides, polyvinyl pyridine or the like. Other suitable polymers can include hydrolyzed acrylonitrile grafted starch, acrylic acid grafted starch, and isobutylene maleic anhydride copolymers, and mixtures thereof.

Suitable high-absorbency materials are described in U.S. Patents 4,699,823 issued October 13, 1987, to Kellenberger et at. And 5,147,343 issued September 15,

1992 to Kellenberger, which are incorporated herein by reference. High absorbency materials are available from various commercial vendors, such as Dow Chemical Company, Stockhausen, Inc., Hoechst Celanese Corporation, and Allied Colloids, Inc. The absorbent core **50** may also include tissue layers or acquisition or distribution layers to help maintain the integrity of fibrous absorbents or transport aqueous liquids.

The absorbent disposable underpant **12** may also include additional components to assist in the acquisition, distribution, and storage of body exudates. For example, the absorbent disposable underpant **12** may include a transport layer or surge layer (intake material) **114**, such as described in U.S. Patent 4,798,603 issued January 17, 1989, to Meyer et al., or a surge management layer, such as described in U.S. Patent 5,486,166 issued January 23, 1996, to Bishop et al., U.S. Patent 5,364,382 issued November 15, 1994, to Latimer et al., U.S. Patent 5,490,846 to Ellis et.al, U.S. patent 5,429,629 to Latimer et.al., U.S. Patent 5,509,915 to Hanson et.al., U.S. Patent 5,192,606 to Proxmire et.a., and European Patent Application EP 0 539 703 A1, published May 5, 1993, which the patents and application are incorporated herein by reference. Such layers may be also referred to as acquisition/distribution layers. A surge layer (intake material) **114** would be positioned within about 0 inch (o cm) to about 4 inches (10.2 cm) from the front end edge **55** of the absorbent core **50**, more typically from about 0 inch (0 cm) to about 2 inches (5.1 cm) from the front end edge **55** of the absorbent core **50** and most typically from about 0 inch (0 cm) to about 1 inch (2.5 cm) from the front end edge **55** of the absorbent core **50**.

The length of the surge layer (intake material) **114** is typically between about 5 inches (12.7 cm) and about 19 inches (48.3 cm), more typically between about 8 inches (20.3 cm) and about 16 inches (40.6 cm), and most typically between about 10 inches (25.4 cm) and about 14 inches (35.6 cm). The length of the surge layer (intake material) **114** is generally about 12 inches (30.5 cm).

The acquisition/distribution layer **52** is disposed on the aqueous liquid storage layer **51** toward the body-facing surface **16** of the absorbent core **50** to help decelerate and diffuse surges of aqueous liquid that may be introduced into the absorbent core **50**. The acquisition/distribution layer **52** may comprise a through-air bonded carded web composed of a blend of 40 percent 6 denier polyester fibers, commercially available from Hoechst Celanese Corporation, and 60 percent 3 denier polypropylene/polyethylene

sheath core bicomponent fibers, commercially available from the Chisso Corporation, with an overall basis weight ranging of from about 50 gsm and about 120 gsm.

Alternative acquisition/distribution materials are described in U.S. Patent 5,192,606 issued March 9, 1993, to D. Proxmire et al.; U.S. Patent 5,486,166 issued January 23, 1996 to Ellis et al.; U.S. Patent 5,490,846 issued February 13, 1996 to Ellis et al.; and U.S. Patent 5,509,915 issued April 23, 1996 to Hanson et al.; the disclosures of which are hereby incorporated by reference. The illustrated acquisition/distribution layer **52** is rectangular with a length of about 191 mm. And a width of about 45 mm. The acquisition/distribution layer **52** can vary in shape and size as disclosed for the absorbent core **50** and the disposable underpant **12**.

One suitable absorbent core **50** comprises a aqueous liquid storage layer **52** in which the basis weight of the absorbent components, such as fluff, pulp, and superabsorbent (SAP), are generally continuous throughout the MD length of the absorbent core **50**. The distribution of the absorbent components are substantially homogeneous in at least the Y direction, preferably in the X and Y directions and may be homogeneous in the Z direction within the absorbent core **50**. The basis weight of the absorbent core **50** can range between about 80 gsm and about 1,000 gsm. More preferably, an acquisition/distribution layer **52** is disposed in the aqueous liquid storage layer **51**, which is typically moved forward on the aqueous liquid storage layer **51**. The fluff pulp/SAP ratio can range from about 100:0 to about 40:60, and more typically from about 80:20 to about 50:50.

The pledget **140** is of a generally rectangular shape and has a peripheral edge **142** with a front edge **144**, a back edge **146**, and side edges **148** and **150** (See **Figure 12**). Pledget **140** has an exterior surface **152** facing away from the wearer and an interior surface **154** facing towards the wearer. The pledget **140** is dimensioned relative to the absorbent core **50** such that its width and length are each less than the width and length of the absorbent core **50**, respectively. In this regard, the length of the pledget **140** is measured along the front and back edges **144** and **146** thereof and the width of the pledget **140** is measured along the side edges **148** and **150** thereof. The length of the absorbent core **50** is measured between the front end edge **55** and the back end edge **57** and the width of the absorbent core **50** is measured between the side edges **59** and **61**.

The pledget **140** is most preferably made from a blend of fibers comprising about 15 to about 30 weight percent polypropylene or polyethylene fibers and about 85 to about 70 weight percent wood pulp fluff fibers, and has a basis weight of about 100 to about 525 gsm. In addition, a superabsorbent is added in an amount of about 10 to about 300 gsm. The pledget **140** may be formed on a tissue or a spunbonded carrier sheet, or may be formed without a carrier sheet.

The pledget **140** is illustrated in the drawings to have a dry thickness that is approximately equal to the dry thickness of the absorbent core **50**. However, it should be appreciated that the pledget **140** and absorbent core **50** can be of different thicknesses. For example, the pledget **140** can be from about one-half to about four time the thickness of the absorbent core **50**.

The pledget **140** can be positioned so as to be symmetrical about the central longitudinal axis A--A, B--B, respectively, of the disposable underpant **12**. When in this position, the front and back edges **144** and **146** of pledget **140** are equi-distant from the front edge **90** and the back edge **92** of the topsheet layer **49**, respectively, and the side edges **148** and **150** of pledget **140** are equi-distant from the side edges **94** and **96** of the topsheet layer **49**, respectively. Further, when in this position, the absorbent core **50** extends past the peripheral edge **142** of the pledget **140**.

The pledget **140** can, however, as illustrated in **Figures 12**, be positioned so that either the front or back edges **144** and **146** is no less than 2 inches (5.1cm) from its respective front or back edges **90**and **92** of the topsheet layer **49** while still being symmetrical about the central longitudinal axis A--A. In other words, the pledget **140** can be asymmetrical about the transverse axis B--B.

In other embodiments of the present invention, the disposable underpant **12** includes a single layer absorbent core **50**. The absorbent core **50** comprises materials adapted to absorb and retain urine, menses, blood or other body excrement. The absorbent core **50** may comprise various natural or synthetic absorbent materials, such as cellulose fibers, surfactant treated meltblown fibers, wood pulp fibers, regenerated cellulose or cotton fibers, a blend of pulp and other fibers, or the like. One such material

is coform material which is composed of a mixture of cellulosic fibers and synthetic polymer fibers. The absorbent core **50** may also include compounds to increase its absorbency, such as 0 - 95 weight percent of organic or inorganic high-absorbency materials, which are typically capable of absorbing at least about 15 and desirably more than 25 times their weight in water. Suitable high-absorbency materials are described in U.S. Patents 4,699,823 issued October 13, 1987, to Kellenberger et at.; and 5,147,343 issued September 15, 1992, to Kellenberger, which are incorporated herein by reference. High-absorbency materials are available from various commercial vendors, such as Dow Chemical Company, Hoechst Celanese Corporation, and Allied Colloids, Inc.

The absorbent core **50** provides the feature of being able to transport aqueous liquid in what can be characterized as in an x- and y-direction and in a z-direction. The transport of aqueous liquid in the z-direction is movement of a wicking nature and gravity flow where the aqueous liquid moves away from the body of the wearer. The transport of aqueous liquid in the x-direction and y-direction is movement and/or wicking of aqueous liquid along the length and width of the absorbent core **50**. As can be appreciated, the movement of aqueous liquid both away from the wearer and along the length and width of the absorbent core **50** results in an increase in the utilization of the area of the absorbent core **50** since the aqueous liquid moves towards the distal ends of the absorbent core **50**, and the result is an improvement of the absorption characteristics of the absorbent core **50**.

As illustrated in **Figures 1a, 1b, 1c, 2a, 2b, 3, 10, 11,** and **12,** the absorbent core **50** has a width that is measured between the side edges **59** and **61** thereof. The absorbent core **50** has a length that is measured between the front end edge **55** and the back end edge **57** thereof. The width and length of the absorbent core **50** are each less than the corresponding width and length of the container **73** comprised of the liquid barrier **48** and the aqueous liquid pervious topsheet layer **49**. The width of container **73** is measured between the side edges **79** and **81** thereof, and the length of the container **73** is measured between the front edge **75** and back edge **77**. However, the width of the absorbent core **50** may exceed the width of the container **73** in an underpant product.

The overall length of the absorbent core **50** should be adequate to help prevent aqueous liquid strike through when sleeping or sitting. Referring to Figures 10, 11, and

12, for the purposes of this invention, the central section **56** is the center one third of the total product length falling between lines **4 - 4** and **5 - 5**. The front section **54** is the one third of the total product length of the disposable underpant **12** that falls between the line **4 - 4** and the front end edge **103** of the disposable underpant **12** and which is typically worn against the anterior side of the wearer's body. The back section **58** of the disposable underpant **12** is that one third of the length of the disposable underpant **12** between line **5 - 5** and the back end edge **105** of the disposable underpant **12** and is typically worn against the posterior side of the wearer's body. This overall length is at least about 10 inches (254 mm) thus extending beyond the central section **56** along the longitudinal centerline A-A of the disposable underpant **12**. Alternatively, the length should be in the range of about 12 inches (305 mm) to about 30 inches (762 mm), more typically ranging from about 15 inches (381 mm) to about 23 inches (584 mm). A common range is from about 15 inches (381 mm) to about 21 inches (533 mm) in length, more typically ranging from about 17 inches (432mm) to about 20 inches (508mm). Optimally, the length of the absorbent core **50** is about 19 inches(483 mm).

The width of the absorbent core **50** extending beyond the crotch portion **18** should be at least as wide as the width of the crotch portion **18**. The width of the absorbent core **50** could be narrowed beyond the crotch portion **18** but may compromise the leakage containment. In some cases, the width of the absorbent core **50** is widened beyond the crotch portion **18**, especially where the disposable underpant **12** includes leg cutouts **29** and **31** in the central section **56**. Because the absorbent core **50** is disposed primarily in the front section **54**, the central section **56**, with less in the back section **58**, a position shifted forward along the longitudinal axis of the disposable underpant **12**, it is understood that the leg cutouts **29** and **31** would also be shifted forward along the longitudinal axis of the disposable underpant **12** to accommodate the position of the disposable underpant **12** on the body of the wearer. The width of the absorbent core **50** extending beyond the crotch portion **18** is from about 2.5 inches (64 mm) to about 12 inches (305 mm), alternatively from about 4.0 inches (102 mm) to about 10 inches (254 mm). A common range is from about 5 inches (127 mm) to about 9 inches (229 mm).

The present invention contemplates various shapes of the absorbent core **50**. One preferred composite has a non-rectangular shape such as an hourglass or I-beamed shaped absorbent core **50**. Another preferred absorbent core **50** embodiment is

rectangular in shape with rounded ends. The essentially rectangular-shaped absorbent core **50** (i.e. an hourglass shape) is more preferred since it can be squared off at the ends to provide a smoother appearance in the back of the disposable underpant **12** while providing a more comfortable body-contouring fit.

Absorbent core **50** is positioned so as to be symmetrical about the central longitudinal axis **A--A** of the underpant **12** and skewed forward along the central transverse axis **B--B** of the underpant **12**. In other words, the side edges **59** and **61** of the absorbent core **50** are equi-distant from side edges **94** and **96** of the aqueous liquid pervious topsheet layer **49**, respectively. The front end and back end edges **55** and **57**, respectively, of the absorbent core **50** are not equi-distant from the front and back edges **103** and **105** of the aqueous liquid pervious topsheet layer **49**, respectively. The absorbent core **50** is disposed in the front section **54**, the central section **56**, and the back section **58**. The front end edge **103** of the absorbent core **50** is from about 10 inches (254 mm) to about 1 inch (25 mm), more preferably from about 9 inches (229 mm) to about 2 inch (51 mm), most preferably from about 8 inches (203 mm) to about 3 inches (76 mm) from the front end edge **103** of the disposable underpant **12**. Optimally, the distance is about 3 inches (76 mm). The back end edge **105** of the absorbent core **50** is from 3 inches (76 mm) to about 13 inches (330 mm) more preferably from about 5 inches (127 mm) to about 12 inches (305 mm), most preferably from about 6 inches (152 mm) to about 11 inches (279 mm) from the back end edge **105** of the disposable underpant **12**.

Referring to **Figures 1a, 1b, 1c, 2a, 2b, 3, 10, 11,** and **12**, in order to further understand what is meant by a skewed forward absorbent core **50** along the central transverse axis it is helpful to define a "skew factor" of the absorbent core **50** which in combination with the presence of an absorbent core **50** in which more of the length of the absorbent core **50** is in the front section **54** than in the back section **58** (the absorbent core **50** is not placed symmetrically in the longitudinal direction, but is skewed forward in the disposable underpant **12**) serves to define the invention. For the purpose of this invention, "not placed symmetrically" means that more than about 20 mm or more of the absorbent core **50** is in the front section **54** as compared to the back section **58**.

The skew factor is calculated using the following steps:

1. Divide the length of the disposable underpant **12** into three sections of equal length: the front section **54**; the central section **56**; and, the back section **58**.

2. Determine what length in the longitudinal or MD direction of the absorbent core **50** along line A-A of **Figures 10, 11,** and **12** is in each section.

3. Calculate the skew factor by dividing the length of the absorbent core **50** in the back section **58** by the sum of the lengths of the absorbent core **50** in the front section **54** and the central section **56**.

Again referring to **Figures 1a, 1b, 1c, 2a, 2b, 3, 10, 11,** and **12**, because absorbent disposable underpant **12** may have a large range of product lengths to fit people from infants through adults, the skew factor in conjunction with the presence of more of the absorbent core **50** in the front section **54** than the back section **58** serves to define the amount of forward skew of an absorbent core **50** for any product length. The skew factor is a function of the overall length of the absorbent core **50** and how it is placed in disposable underpant **12**. Because the overall length of disposable underpant **12** affects how much of the absorbent core **50** is in the front section **54**, the central section **56**, and the back section **58**, the skew factor is also a function of the length of the disposable underpant **12**. Placement of the absorbent core **50** in any various product designs and sizes of disposable underpants **12** depend on how that particular disposable underpant **12** is designed to fit on the wearer's body and the ability of the manufacturing process to control the placement of the absorbent core **50** within the disposable underpant **12**. For the purposes of this invention, the skew factor can be any value less than about 0.155. The skew factor ranges from about 0 to about 0.155, more preferably from about 0 to about 0.12, most preferably from about 0 to about 0.10. In some designs, it may be desirable to apply skew factors ranging from about 0 to about 0.090.

For embodiments where none of the absorbent core **50** is placed in the back section **58**, the skew factor becomes zero. Therefore, the range of skew factors disclosed in this invention for disposable underpants **12** having absorbent cores **50** with a greater length in the front section **54** than in the back section **58** is 0 to 0.270. For the disposable underpant **12** shown in **Figures 10, 11,** and **12**, the range of skew factors is from 0 to

0.270 and more preferably from 0 to 0.20 and most preferably from 0.07 to 0.195.

Referring to **Figures 10, 13a, and 14**, in another embodiment, a disposable underpant **12** has a length of 845 mm, a width of 715 mm at the ends along line 9 - 9 and a minimum width of 120 mm in the central section **56** along line 8 - 8 and comprises an absorbent core **50** which has an MD length of 438 mm and a CD width of 153 mm at the ends and of 89 mm in the center of the leg cutout **29** and **31** along line 8 - 8. The absorbent core **50** is placed on aqueous liquid impervious barrier **48**. The absorbent core **50** also has a high basis weight pocket region **141** which has a length of 279 mm, a width of 89 mm along line 8 - 8 and a width of 102 mm at the ends.

Referring to **Figures 13a and 14**, the absorbent core **50** comprises a homogeneous mixture of 129 gsm (grams per square meter) of DOW 2035 high absorbency material (available from the DOW Chemical Company, Midland MI) and 215 gsm of Alliance CR1654 fluff pulp fibers in the end regions **700** and **701**. In the pocket region **141**, the basis weight of the high absorbency material is 261 gsm and of the fluff pulp is 435 gsm. There is also a carded web intake material **114** in the disposable underpant **12** which is 330 mm long and 76 mm wide with a basis weight of 85 gsm comprising a mixture of 40% by weight 6 denier polyester fibers from Hoechst Celanese and 60% 3 denier sheath core polyethylene / polypropylene crimped fibers from CHISSO Corporation of Japan. The intake material **114** is located between the topsheet layer **49** and the absorbent core **50**. The absorbent core **50** has a retention capacity of about 500 grams of 0.9% sodium chloride in water. Importantly, the absorbent core **50** is placed in disposable underpant **12** so that the front end edge **55** of absorbent core **50** is 163 mm from the front end edge **103** of disposable underpant **12**. Furthermore, the front end edge **720** of the pocket region **141** is placed 222 mm from front end edge **103** of the disposable underpant **12**. Finally, an 85 gsm surge material (intake material) (not shown) with a length dimension of 279 mm and a width of 64 mm is placed coextensive with the pocket region **141** in the length dimension and centered in the width dimension is placed on the interior surface **65** of the absorbent core **50**. The absorbent core **50** has a retention capacity of about 500 grams of 0.9% sodium chloride in water. This results in 27.1 % of the length of the absorbent core **50** in the machine direction being placed in the front section **54** of the disposable underpant **12**, 64.2% of the length of the absorbent core **50** is in the central section **56** of the disposable underpant **12**, and 8.7% of the length of the

absorbent core **50** is in the back section **58** of the disposable underpant **12**. The absorbent core **50** has a skew factor of 0.095. Additionally, 21.5% of the length of the pocket area **141** is in the front section **54**, 78.5% of the length of the pocket area **141** is in the central section **56**, and 0.0% of the length of the pocket area **141** is in the back section **58**. The absorbent core **50** and the intake material **114** placement is symmetric in the CD dimension of the disposable underpant **12** along the central longitudinal axis A-A in **Figure 11**. When placed on the body of the wearer, this configuration results in a greater proportion of the absorbent core **50** being on the anterior side of the wearer where it is more likely to be used.

Compared to symmetric placement of an absorbent pad or core in the MD length of a disposable underpant resulting in equal placement of the absorbent pad or core in the anterior and posterior portions of such a disposable underpant, the skewed forward configuration described above results in higher utilization of the absorbent core **50** and prevents unsightly and uncomfortable bulk in the back section **58** of the disposable underpant **12**.

Referring to **Figures 11**, **13a**, and **14** in yet another embodiment a disposable underpant **12** has a length of 845 mm, a width of 715 mm at the ends along the line 9 - 9 and a minimum width of 120 mm in the central section **56** along line 8 - 8 and comprises an absorbent core **50** which has an MD length of 489 mm and a CD width of 153 mm at the ends and of 89 mm in the center of the leg cutout **29** and **31** along line 8 - 8. The absorbent core **50** is placed on the aqueous liquid impervious barrier **48**. The absorbent core **50** also has a high basis weight pocket region **143** which has a length of 489 mm (full length of the absorbent core **50**), a width of 89 mm along line 8 - 8 and a width of 102 mm at the ends.

Referring to **Figures 13b** and **14**, the absorbent core **50** comprises a homogeneous mixture of 114 gsm (grams per square meter) of DOW 2035 high absorbency material (available from the DOW Chemical Company, Midland MI) and 232 gsm of Alliance CR1654 fluff pulp fibers in the side end regions **721** and **722**. In the pocket region **143**, the basis weight of the high absorbency material is 282 gsm and of the fluff pulp is 591 gsm. The absorbent core **50** has a retention capacity of about 800 grams of 0.9% sodium chloride in water. Importantly, the absorbent core **50** is placed in the

disposable underpant **12** so that the front end edge **55** of absorbent core **50** is 112 mm from the front end edge **103** of the disposable underpant **12.** Finally, an 85 gsm surge material (intake material) (not shown) with a length dimension of 279 mm and a width of 64 mm is placed 187 mm from the front end edge **103** of the disposable underpant **12** and is centered in the width dimension along the central longitudinal axis A-A is placed on the interior surface **65** of the absorbent core **50.**

This results in 34.7 % of the length of absorbent core **50** in the machine direction being placed in the front section **54** of the disposable underpant **12**, 57.6 % of the length of the absorbent core **50** is in the central section **56** of the disposable underpant **12**, and 7.7% of the length of the absorbent core **50** is in the back section **58** of the disposable underpant **12**. The absorbent core **50** has a skew factor of 0.082. The absorbent core **50** and the intake material **114** placement is symmetrical in the CD dimension of the disposable underpant **12** along the central longitudinal axis A-A. When placed on the body of the wearer, this configuration results in a greater proportion of the absorbent core **50** being on the anterior side of the wearer where it is more likely to be used.

Compared to symmetric placement of an absorbent pad or core in the MD length of a disposable underpant resulting in equal placement of the absorbent pad or core in the anterior and posterior portions of such a product, the skewed forward configuration described above results in higher utilization of the absorbent core **50** and prevents unsightly and uncomfortable bulk in the back section **58** of the disposable underpant **12.**

Example

Two absorbent disposable underpant products were tested for leakage protection performance. The disposable underpants were sent to 72 incontinent panelists (44 females, 28 males) who used them under normal use conditions. A diary sheet, with pre-written questions, was provided for all individual products on which panelists recorded information pertaining to leakage. All used products were returned and weighed to determine the amount of urine they contained.

From the combined data, a stepwise procedure for logistic regression was used to determine the best fitting model for the leakage data. The goal of logistic regression is to

describe the relationship between leaks and the set of explanatory variables (codes, urine grams, gender, activity, and panelist hip size).

The disposable underpant products tested were a prototype disposable underpant and the SureCare® Slip-On Undergarment produced by Inbrand Corporation of Marietta, Georgia. The Slip-on product is a traditional pant with a symmetrical placement of the absorbent core in the product chassis while the prototype disposable underpant had a highly skewed forward absorbent core with less capacity than the SureCare product.

The SureCare product is 660 mm long and has an essentially rectangular absorbent core which is 550 mm long and 127 mm wide. The absorbent core has 90 gsm of high absorbency material and 1062 gsm of fluff pulp. The absorbent core is placed 55 mm from the front and back end edges of the garment.

The prototype disposable underpant (referring to **Figure 10**) has a product length of 781 mm. The absorbent core is 400 mm long and 165 mm wide at the ends and 90 mm wide in the center. The absorbent core is placed 160 mm from the front end edge of the prototype disposable underpant and 221 mm from the back end edge of the prototype underpant. The absorbent core comprises 110 gsm of high absorbency material and 165 gsm of fluff fibers.

In addition, the prototype disposable underpant has a pledget which is 292 mm long, 90 mm wide and placed 185 mm from the front end edge of the prototype underpant and 304 mm from the back end edge of the prototype underpant between the absorbent core and the liquid barrier. The pledget is comprised of 180 gsm of the high absorbency material and 270 gsm of the fluff fibers. The density of the absorbent core and the pledget is about 0.160 gm / cc.

In addition, the prototype disposable underpant has a 100 gsm intake material which is 64 mm wide and 203 mm long. The front end edge of the intake material is 216 mm from the front end edge of the prototype disposable underpant and 362 mm from the back end edge of the prototype disposable underpant.

The proportions of the absorbent core and the pledget in the front section, central

section, and back section of the prototype disposable underpant are shown in Table 5. Table 5 shows that the absorbent core, the pledget, and the intake material of the prototype disposable underpant are skewed to the front of the prototype disposable underpant with higher proportions of the absorbent core in the front while the SureCare product has a symmetric placement of its absorbent core.

TABLE I

Dimensional Comparison of Prototype Disposable Underpant and SureCare Slip-On

Product	Absorbent Component	% in Front Region	% in Central Region	% in Back Region	Retention Capacity 0.9% Saline
Sure-Care	Absorbent Core	30.0	40.0	30.0	726 g
Proto-type	Absorbent Core	25.0	65.0	9.8	480 g
Dispos-able	Pledget	25.7	74.3	0.0	
Under-pant	Intake Material	21.2	78.8	0.0	

The SureCare product in TABLE I does not have a skew factor because the placement of the absorbent core is symmetric. On the other hand, the skew factor of the absorbent core of the prototype disposable underpant is 0.111, showing the absorbent core to be highly skewed forward.

The leakage information in TABLE II, expressed as the urine load in grams at which 20% (LD20) and 50% (LD50) of the products leak clearly shows that the prototype disposable underpant with the skewed forward absorbent core provides better leakage protection because a higher urine load is needed to make 20% and 50% of the products leak.

TABLE II

Leakage Protection of SureCare Slip-on versus Prototype Disposable Underpant

Product	Gender	LD20, grams	LD50, grams
SureCare	Male	240	367
	Female	84	231
Prototype Disposable Underpant	Male	294	450
	Female	294	441

While specific embodiments of a disposable underpant **12** is shown in the **Figures**, it is understood that it is contemplated that any disposable underpant product can incorporate the absorbent core **50** being placed such that the product would have a skew factor of at least 0.27.

Preferably, the thickness of the absorbent core **50** is less than about 45 mm. The thickness of the absorbent core **50** may range from about 4 mm to about 40 mm. Preferably, the thickness ranges from about 5 mm to about 30 mm with a thickness having a most preferred range from about 6 mm to about 20 mm. The thickness is measured on a 4 inch (102 mm) smooth unbuckled square sample (elastics removed) with a Mitutoyo Digamatic Indicator using a 3 inch (76 mm) diameter acrylic platen and assembly to produce a pressure of 0.05 psi.

In construction of the absorbent barrier composite **46**, the liquid barrier **48** should retard the movement of the liquid through the absorbent barrier composite **46** by making the liquid barrier **48** resistant to penetration normally encountered under wearing conditions. The absorbent barrier composite **46** may be rendered liquid impermeable by any method well known in the art such as coating the absorbent core **50** or by securing a separate liquid impermeable material to the absorbent core **50**.

The liquid barrier **48** has an exterior surface **99** that faces away from the wearer and

an interior surface **98** that faces toward the wearer. The liquid barrier **48** may comprise a thin, liquid impervious web or sheet of plastic film such as polyethylene, polypropylene, polyvinyl chloride or similar material. Alternately, the liquid barrier **48** may comprise a nonwoven, fibrous web which has been suitably constructed and arranged to have low liquid perviousness. Still alternately, the liquid barrier **48** may comprise a layered or laminated material, such as a thermally bonded plastic film and nonwoven web composite. Alternatively, the liquid barrier **48** consists of a liquid impervious film or foam which is pervious to water vapor under normal wearing conditions. More preferred, the liquid barrier **48** has a water vapor transmission rate of at least about 1000 grams/m^2/day measured by ASTM E96-92. One example of a suitable film is a 39.4 grams per square meter microporous film produced by Mitsui and sold by Consolidated Thermoplastics (CT) under the tradename of ESPOIR® N-TAF-CT.

The liquid barrier **48** desirably comprises a material that is formed or treated to be fluid impermeable. Alternatively, the liquid barrier **48** may comprise a fluid permeable material and other suitable means (not shown), such as a fluid impermeable layer associated with the absorbent barrier composite **46** (or the absorbent core **50**), may be provided to impede fluid movement away from the absorbent barrier composite **46** (or the absorbent core **50**). The liquid barrier **48** may comprise a single layer of material or a laminate of two or more separate layers of material. Acceptable materials include a single spunbonded layer, two layers of spunbonded and meltblown materials, or three-layer material of spunbonded - meltblown - spunbonded material.

Suitable materials for the liquid barrier **48** include thermoplastic films, wovens, nonwovens, laminates of films, wovens, and/or nonwovens, foams, or the like. For example, the liquid barrier **48** may comprise a thin, substantially fluid impermeable web or sheet of plastic film such as polyethylene, polypropylene, polyvinyl chloride, or similar material. One suitable material for the liquid barrier **48** is a 0.028 millimeter (mm) thick polyethylene film with a systematic matte embossed pattern and that has been corona treated on both sides.

The liquid barrier **48** is needed to prevent liquid strike through to the outer clothing when discharge occurs onto the absorbent barrier composite **46** of the underpant **12**. The liquid barrier **48** is located on the inside of the outer cover **13** in at least the crotch portion

18 and consists of a liquid impervious film such as polyethylene. Use of only the film (without the outer cover 13) would be hot and uncomfortable, may not be durable enough to withstand extended periods of wear. The absorbent core 50 may be associated with a liquid barrier 48 which may or may not include elastic characteristics.

The absorbent barrier composite 46 includes a substantially fluid impermeable liquid barrier 48, a fluid (or liquid) permeable topsheet layer 49 superposed on the outer cover 13. (See Figures 1a, 8, and 9.) The absorbent core 50 is sandwiched between the liquid barrier 48 and the topsheet layer 49. (See Figures 1a, 8, and 9.) The liquid barrier 48 and the topsheet layer 49 are desirably longer and wider than the absorbent core 50. The topsheet layer 49 is designed to be positioned toward the wearer and is referred to as the body-facing surface 16. Conversely, the liquid barrier 48 is designed to be positioned toward the outer cover 13 and the outer clothing of the wearer and is referred to as the garment-facing surface 23.

The topsheet layer 49 has an exterior surface 109 that faces away from the wearer and an interior surface 108 that faces towards the wearer. The topsheet layer 49 consists of a nonwoven or other soft material for contacting the wearer's skin. The topsheet layer 49 is formed of a soft flexible porous aqueous liquid pervious material so that aqueous liquid waste, and possibly semi-solid waste as well, can pass through to the absorbent core 50 and be absorbed by the absorbent barrier composite 46 (or absorbent core 50). A suitable topsheet layer 49 may be comprised a nonwoven web, a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments or fibers, such as polypropylene, polyethylene, polyesters or the like, a perforated film, reticulated foams, an expanded plastic webbing material, scrim material, or a web or natural polymer filaments or fibers such as wood, rayon, or cotton. The topsheet layer 49 has a pore size that readily allows the passage therethrough of air, sweat, perspiration due to the breathability of the material.

Suitably, the topsheet layer 49 is a nonwoven spunbond. Such spunbond material is available from Kimberly-Clark Corporation, located in Roswell, GA. The topsheet layer 49 has a weight from about 0.3 osy to about 2.0 osy and alternatively about 0.5 osy. The topsheet layer 49 of the underpant may be printed, colored, decoratively embossed, or perforated with discrete slits or holes extending therethrough.

In addition, the topsheet layer **49** may be treated with a surfactant to aid in fluid transfer. In one particular embodiment, the topsheet layer **49** comprises a nonwoven, spunbond web of sheath core bicomponent filaments with 50 percent polyethylene and 50 percent polypropylene having a basis weight of about 20 grams per square meter (gsm). The fabric is surface treated with a surfactant commercially available from Union Carbide Chemicals and Plastics Company, Inc., of Danbury, Connecticut, U.S.A. under the trade designation TRITON X-102.

The width of the crotch portion **18** between the crotch elastics **37** and **39** should be wide enough to accommodate the absorbent core **50** between the side edges **17** and **19** of the crotch portion **18** without having the absorbent core **50** obstruct the crotch elastics **37** and **39** and ultimately the leg elastics **32**, **33**, **34**, and **35**. This allows the crotch elastics **37** and **39** to contract and draw up the sides of the crotch creating a bucket with walls of the topsheet layer **49** and liquid barrier **48** to keep bodily exudates from leaking out of the product and to accommodate more sizes of individuals. However, in some product designs, the crotch elastics **37** and **39** may be covered by at least a portion of the absorbent core **50**.

The width of the crotch portion **18** should not be so wide as to seem bulky or uncomfortable, but a suitable width is at least about 2.5 inches (64 mm) between the crotch elastics **37** and **39**. The width is advantageously ranges from about 2.5 inches (64 mm) to about 6.0 inches (152 mm). Typically the width of the crotch portion **18** between the crotch elastics **37** and **39** ranges from about 3.5 inches (89 mm) to about 5 inches (127 mm). Preferably, the width so defined is about 4.25 inches (108 mm).

The crotch portion **18** is at least about 0.25 inch (6 mm) wider than the width of the absorbent core **50**. The crotch portion **18** is from about 0.25 inch (6 mm) to about 4 inches (102 mm) wider than the absorbent core **50**. Typically the crotch portion **18** is from about 0.5 inch (13 mm) to about 3 inches (76 mm) wider than the absorbent core **50** and more typically from about 0.5 inch (13 mm) to about 2 inches (51 mm) wider. Preferably, each of the crotch elastics **37** and **39** are from about 0.2 inch (5 mm) to about 0.8 inch (20 mm) wide. More preferably, the width of each crotch elastics **37** and **39** is from about 0.2 inch (5 mm) to about 0.4 (10 mm). The overall width of the crotch portion **18** includes the

width between the crotch elastics **37** and **39**, the width of the crotch elastics **37** and **39** and the ruffle material outside the crotch elastics **37** and **39** to the edge of the leg openings **28** and **30**. In some embodiments of the present invention, the absorbent core **50** may be from about 0 inches (0 mm) to about 1 inch (25 mm) wider than the crotch portion **18**.

Preferably, ruffle material on the edge of the leg openings **28** and **30** outside the leg and crotch elastics **32**, **33**, **34**, **35**, **37**, and **39** is less than about 0.5 inch (13 mm). More preferably, the ruffle material is less than about 0.125 inch (3 mm). It is most desirable to eliminate the ruffle material from the edge of the leg openings **28** and **30**.

The width of the absorbent barrier composite **46** is sized in relation to the width of the crotch portion **18**. The width of the composite **46** is at least the width of the crotch portion **18** between the crotch elastics **37** and **39**. Preferably, the width is equivalent to the width of the crotch portion **18**.

The overall length of the absorbent barrier composite **46** should be adequate to extend beyond the ends of the absorbent core **50** to help prevent liquid strike through at these points when sleeping or sitting. This overall length is at least about 12 inches (305 mm) thus extending beyond the crotch portion **18** along the longitudinal centerline A-A of the underpant **12**. Alternatively, the length should be in the range of about 12 inches (305 mm)to about 30 inches (762 mm), more typically ranging from about 15 inches (381 mm) to about 23 inches (584 mm). A common range is from about 17 inches (432 mm) to about 21 inches (533 mm) in length. Optimally, the length of the composite **46** is about 19 inches(483 mm).

The width of the absorbent barrier composite **46** extending beyond the crotch portion **18** should be at least as wide as the width of the crotch portion **18**. The width of the absorbent barrier composite **46** could be narrowed beyond the crotch portion **18** but may compromise the leakage containment. Typically the width of the absorbent barrier composite **46** is widened beyond the crotch portion **18**. The width of the absorbent barrier composite **46** extending beyond the crotch portion **18** is from about 2.5 inches (64 mm) to about 12 inches (305 mm), alternatively from about 4.0 inches (102 mm) to about 10 inches (254 mm). A common range is from about 7 inches (178 mm) to about 9 inches

(229 mm). Optimally, the width is about 8 inches (203 mm).

The present invention contemplates various shapes of the absorbent barrier composite **46**. One preferred composite has a non-rectangular shape such as an hourglass or I-beamed shaped absorbent barrier composite **46** which provide extensive coverage in the seat of the finished underpant **12**. Another preferred absorbent barrier composite **46** embodiment is rectangular in shape with rounded ends. The essentially rectangular-shaped absorbent barrier composite **46** (i.e. an hourglass shape) is more preferred since it can be squared off at the ends to provide a smoother appearance in the back of the underpant **12** while providing a more comfortable body-contouring fit.

Referring to **Figures 1a - c, 2a - b, 3**, and **6**, the waist portion elastic **22** are shown covered with a body liner **80**. The body liner **80** consists of a nonwoven or other soft material for contacting the wearer's skin. The body liner **80** is described in more detail below. In other embodiments, at least a portion of the waist portion elastic **22** may be covered by the absorbent barrier composite **46**. Referring to **Figures 3** and **4**, the leg elastics **32, 33, 34**, and **35** are shown covered by the body liner **80**. In **Figure 1b**, the crotch elastics **37** and **39** are shown sandwiched between the topsheet layer **49** and the liquid barrier **48**. In alternative embodiments, the crotch elastics **37** and **39** can be sandwiched between the outer cover **13** and the liquid barrier **48**. Depending on the size and shape of the absorbent barrier composite **46**, at least a portion of the leg elastics **32, 33, 34**, and **35** may be covered by the absorbent barrier composite **46**.

Referring to **Figures 5** and **7**, the waist elastic **21** are shown in another embodiment as covered with a waist liner **26**. The waist elastic **21** could also be covered with the body liner **80**. Referring to **Figures 5** and **7**, the leg elastics **32** and **34** are shown covered by a leg liner **38**. Depending on the size and shape of the absorbent barrier composite **46**, at least a portion of the leg elastics **32, 33, 34**, and **35** may be covered by the absorbent barrier composite **46**. In **Figure 1a**, the crotch elastics **37** and **39** are shown covered by the absorbent barrier composite **46** as the crotch elastics **37** and **39** are sandwiched between the outer cover **13** and the absorbent barrier composite **46**. Referring to **Figure 7**, the waist portion elastic **22** are shown covered with a body liner **80**. The body liner **80** consists of a nonwoven or other soft material for contacting the wearer's skin. In other embodiments, at least a portion of the waist portion elastic **22** may be covered by the absorbent barrier composite **46**.

The body liner **80** is compliant and soft feeling to the wearer. The body liner **80** may be any soft, flexible, porous sheet which is liquid pervious, permitting liquids to readily penetrate into its thickness, or impervious, resistant to the penetration of liquids into its thickness. A suitable body liner **80** may be manufactured from a wide range of materials, such as natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of natural and synthetic fibers or reticulated foams and apertured plastic films.

There are a number of manufacturing techniques which may be used to manufacture the body liner **80**. For example, the body liner **80** may be woven or nonwoven web or sheet such as a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments, such as polypropylene, polyethylene, polyesters or the like, or a web of natural polymer filaments such as rayon or cotton. The bonded-carded web may be thermally bonded or sprayed with a binder by means well known to those skilled in the fabric art. Suitably, the body liner **80** is a nonwoven spunbond. Ideally, the body liner **80** is a spunbond polypropylene nonwoven with a wireweave bond pattern. Suitably, the spunbond material is available from Kimberly-Clark Corporation, located in Roswell, GA. The body liner **80** has a weight from about 0.3 oz. per square yard (osy) to about 2.0 osy and alternatively about 0.6 osy. The body liner **80** of the underpant maybe printed, colored or decoratively embossed. The body liner **80** has a pore size that readily allows the passage therethrough of air, sweat, perspiration due to the breathability of the material. The body liner **80** may be selectively embossed or perforated with discrete slits or holes extending therethrough.

The position and the shape of the leg openings **28** and **30** are important to avoid tightness in the crotch and groin area of the wearer, to obtain adequate buttocks coverage, and to prevent the underpant **12** from tilting forward, i.e. tilting such that the front waist edge dips lower in relationship to the back waist edge. **Figure 1a** illustrates the most preferred design for leg fit and buttocks coverage. The shape of the curve across the front edges **72** and **74** of the leg openings **28** and **30** may have an impact on the fit of the underpant **12**. If the curve is too deep, the underpant **12** will shift downward and backward resulting in a short front waist, increased back length and bagginess in the seat of the underpant **12**. This causes the underpant **12** to appear tilted when worn as

evidenced by an unevenness around the waist of the wearer, resulting in tightness along the front edges **72** and **74** of the leg openings **28** and **30** and reducing the comfort in the fit.

The structures of the leg openings **28** and **30** are important to the correct functioning of the underpant **12**. With the underpant **12** laid out flat as in **Figure 1a**, the majority (at least 51%) of the back edges **76** and **78** of the back portions **82** and **84** of the leg openings **28** and **30** respectively preferably forms a substantially linear line. More preferably, the back edges **76** and **78** of the back portions **82** and **84** of the leg openings **28** and **30** are substantially linear for a length, □, of at least about 70% of the length of the entire back portions **82** and **84**. The straight section □ of the back edges **76** and **78** of the back portions **82** and **84** of the leg openings **28** and **30** should form an acute angle with the longitudinal centerline, A-A, of the underpant **12**. Preferably, the line, □, forms an angle, □, with the centerline A-A of the underpant **12** of between about 45□ and about 89□, more preferably between about 55□ and about 87□ and most preferably between about 61□ and about 76□. If a shallow curve (a curve having a radius of at least 6 inches) defines the back edges **76** and **78** of the back portions **82** and **84** of the leg openings **28** and **30**, two points are selected along the curve, one point is positioned at about 25% of length of the curve and the other point is positioned at about 75% of the length of the curve. A line drawn between the two points is used to determine the □ angle formed with the centerline A-A of the underpant **12**. The back edges **76** and **78** forming acute angles with the longitudinal centerline as disclosed reduce bunching and shifting of the absorbent core **50** during use, ensuring a better contouring to the body and comfortable fit. Such angles help the underpant **12** to under cut the buttocks, improving fit and reducing leakage. It is understood that because the leg elastics **34** and **35** closely follow the back edges **78** and **76** respectively, the references to the back edges **78** and **76** can be read to describe the leg elastics **34** and **35**.

The majority (at least 51%) of the front edges **72** and **74** of the front portions **86** and **88** of the leg openings **28** and **30** include lengths □, preferably forming straight lines. More preferably, the lengths of front edges **72** and **74** (□□ of the leg openings **28** and **30** are substantially linear for at least about 70% of the length of the front portions **86** and **88** of the leg openings **28** and **30**. The substantially linear section □ of the front edges **72** and **74** of the front portions of the leg openings **28** and **30** should form an angle □ with the

centerline of the underpant **12** of between about 62□ and about 99□, more preferably between about 74□ and about 91□, and most preferably about 85□. The front edges **72** and **74** forming an angle with the centerline as disclosed reduce bunching and shifting of the absorbent core **50** during use, ensuring a better contouring to the body and comfortable fit. If a shallow curve (a curve having a radius of at least 6 inches) defines the front edges **72** and **74** of the front portions **86** and **88** of the leg openings **28** and **30**, two points are selected along the curve, one point is positioned at about 25% of length of the curve and the other point is positioned at about 75% of the length of the curve. A line drawn between the two points is used to determine the □ angle formed with the centerline of the underpant **12**. While front edges **72** and **74** forming angles of 90□ can be used, angles at least slightly greater or less than 90□ provide an underpant **12** having a comfortable fit during movement. It is understood that because the leg elastics **32** and **33** closely follow the front edges **72** and **74** respectively, the references to the front edges **72** and **74** can be read to describe the leg elastics **32** and **33**.

Likewise, the shape of the curve in the crotch portion **18** is important. The majority of the side edges **17** and **19** of the crotch portion **18** include lengths □, preferably forming curved (arcuate) lines. If the curve is too shallow or straight (especially at the ends of the crotch elastics **37** and **39**), tightness may be experienced at the inner groin area and gapping in the fit of the underpant **12** as the underpant **12** does not follow the contour of the wearer's leg, resulting in leakage. The preferred narrow crotch width having shallow curves may also reduces the coverage of the buttocks. To compensate for such reduction, the back leg edges **76** and **78** on the back portions **82** and **84** are preferably adjusted downward, increasing the □ angle. The curve between the side edges **17** and **19** of the crotch portion **18** and the back portions **82** and **84** of the leg openings **28** and **30** should start slightly in front of centerline B-B of the underpant **12**, see **Figure 1a**. This allows the back leg elastics **34** and **35** to be positioned below the lower edge of the buttocks and helps prevent the underpant **12** from riding up when walking. This means that the curved crotch portion □ of the leg openings **28** and **30** are entirely forward of the underpant **12** centerline B-B. It is understood that because the crotch elastics **37** and **39** closely follow the edges **17** and **19** respectively, the references to the edges **17** and **19** can be read to describe the leg elastics **37** and **39**.

While the leg elastics **32**, **33**, **34**, and **35** can be designed to closely follow the edge

of the absorbent core **50** outside of the crotch portion **18**, moving the leg elastics **32**, **33**, **34**, and **35** away from the absorbent core **50**, the absorbent core **50** interfers less with the function of the leg elastics **32**, **33**, **34**, and **35**, providing better gasketing around the leg openings **28** and **30**. In addition, as absorbent core **50** swells as it absorbs bodily discharges, the leg elastics **32**, **33**, **34**, and **35** so positioned are better able to remain in contact with and conformed to the wearer's body.

In a preferred embodiment, the waist portion and leg elastics **22**, **32**, **33**, **34**, and **35**, respectively, (and in embodiments including waist elastic **21**) are attached to the underpant **12** sandwiched between the outer cover **13** and the body liner **80** in generally a stretched state by means known in the art, including ultrasonic bonded, heat/pressure bonded or adhesively bonded. The crotch elastics **37** and **39** are sandwiched between the liquid barrier **48** and the topsheet layer **49** of the absorbent barrier composite **46**. The crotch elastics **37** and **39** are typically attached in a stretched state by means known in the art, including ultrasonic bonded, heat/pressure bonded or adhesively bonded. Materials suitable for the elastics include a wide variety including but not limited to elastic strands, yarn rubber, flat rubber, elastic tape, film-type rubber, polyurethane and elastomeric, tape-like elastomeric or foam polyurethane or formed elastic or non-elastic scrim. Suitable material is sold under the name LYCRA® by the DuPont Company located in Wilmington, Delaware. Each elastic may be unitary, multi-part or composite in construction before integrating into the underpant **12**.

In an alternative embodiment, the waist portion, leg, and crotch elastics **22**, **32**, **33**, **34**, **35**, **37**, and **39**, respectively, (and in embodiments including waist elastic **21**) are attached to the underpant **12** sandwiched between the outer cover **13** and the body liner **80** in generally a stretched state by means known in the art, such as ultrasonic bonded, heat/pressure bonded or adhesively bonded. Materials suitable for the elastics include a wide variety including but not limited to elastic strands, yarn rubber, flat rubber, elastic tape, film-type rubber, polyurethane and elastomeric, tape-like elastomeric or foam polyurethane or formed elastic or non-elastic scrim. Suitable material is sold under the name LYCRA® by the DuPont Company located in Wilmington, Delaware. Each elastic may be unitary, multi-part or composite in construction.

The portion of the front and back body portions **14** and **15** having waist portion elastic **22** is from about 1 inch (25 mm) to about 10 inches (254 mm) wide (perpendicular to A-A as shown in **Figure 1a**). More typically, the portion of the front and back body portions **14** and **15** having waist portion elastic **22** is from about 3 inches (76 mm) to about 8 inches (203 mm) wide. More typically, the width ranges from about 6 inches (152 mm) to about 7.5 inches (191 mm). In some embodiments it is desirable to vary the widths of waist portion elastic **22** between the front and back body portions **14** and **15**. If one of the body portions **14** and **15** has a narrower portion of waist portion elastic **22**, the width ranges between about 1 inch (25 mm) to about 8 inches (203 mm), more typically from about 3 inches (76 mm) to about 6 inches (152 mm), and most typically from about 4 inches (102 mm) to about 5.5 inches (140 mm). The waist portion elastic **22** is applied under an elongation of from about 100% to about 400%, more typically under an elongation of from about 150% to about 300%, and most typically under an elongation of from about 200% to about 275%. The underpant **12** may be constructed such that the tension of the waist portion elastic **22** may be a different value in the front body portion **14** as compared to the tension of the waist portion elastic **22** in the back body portion **15**.

The waist portion elastic **22** may comprise threads, strands, ribbons, bands, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the waist portion elastic **22** ranges from about 1 to about 100, more typically from about 10 to about 40, and most typically from about 15 to about 35. Preferably, when the waist portion elastic **22** are threads, 15 to 40 threads are used as the waist portion elastic **22** and the threads are spaced from about 0.0625 inch (1.6 mm) to about 2 inches (51 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.5 inch (13 mm), and most preferably about 0.25 inch (6 mm) apart. While the appearance of the underpant **12** may be enhanced by the close even spacing of the elastic material, such as threads, in the waist portion elastic **22**, however, the distance between the pieces of elastic material can be varied. Such variation can be used in the front and back waist edge portions **44** and **45** to give the appearance of a waist band.

In a preferred embodiment, the elastic threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable waist portion elastic **22**

include threads having a decitex (g/10000m) of about 100 to about 1200, more typically from about 470 to about 940, and most typically from about 620 to about 740 for waist portion elastic **22** comprising from about 15 to about 35 threads. Adhesive **71**, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the waist portion elastic **22** to the outer cover **13** and the body liner **80**. Preferably the adhesive **71** is applied only to the waist portion elastic **22**. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

In embodiments that include waist elastic **21**, the waist elastic **21** is from about 0.0625 inch (1.6 mm) to about 2 inches (51 mm) wide. More typically, the front and back waist edge portions **44** and **45** of the front and back body portions **14** and **15** respectively having waist elastic **21** is from about 0.25 inches (6 mm) to about 1.5 inch (38 mm) wide. More typically, the width ranges from about 0.5 inches (13 mm) to about 1 inches (25 mm). The waist elastic **21** is applied under an elongation of from about 150% to about 300%, more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The waist elastic **21** may comprise threads, strands, ribbons, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the waist elastic **21** ranges from about 1 to about 20, more typically from about 2 to about 10, more typically from 2 to about 8, and most typically from about 2 to about 6. Preferably, when the waist elastic **21** are threads, 3 to 6 threads are used as the waist elastic **21** and the threads are spaced from about 0.0625 inch (1.6 mm) to about 1.5 inches (38 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable waist elastic **21** include threads having a decitex (g/10000m) of from about 100 to about 1200, more typically from about 470 to about 940, and most typically from about 620 to about 940 for waist elastic **21** comprising from about 5 to about 10 threads. Adhesive **71**, typically applied in a meltblown or swirl pattern using

currently known technology, is used to bond the waist elastic **21** to the outer cover **13** and the body liner **80** or waist liner **26**. Preferably the adhesive **71** is applied only to the waist elastic **21**. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

The leg elastics **32**, **33**, **34**, and **35** are from about 0.0625 inch (1.6 mm) to about 1 inch (25 mm) wide, more typically from about 0.25 inch (6 mm) to about 1 inch (25 mm), and most typically from about 0.25 inch (6 mm) to about 0.75 inch (18 mm). The leg elastic **32**, **33**, **34**, and **35** is applied under an elongation of from about 100% to about 300%, more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The leg elastics **32**, **33**, **34**, and **35** may comprise threads, strands, bands, ribbons, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the leg elastic **32**, **33**, **34**, and **35** ranges from about 1 to about 6, more typically from about 2 to about 5, and most typically from about 3 to about 4. Preferably, when the leg elastic **32**, **33**, **34**, and **35** are threads, 1 to 6 threads are used as the leg elastic **32**, **33**, **34**, and **35**, and the threads are spaced from about 0.0625 inch (1.6 mm) to about 0.5 inches (13 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable leg elastics **32**, **33**, **34**, and **35** include threads having a decitex (g/10000m) of from about 470 to about 1200, more typically from about 620 to about 1000, and most typically from about 740 to about 940 for leg elastics **32**, **33**, **34**, and **35** having comprising from about 3 to about 6 threads. Adhesive **71**, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the leg elastics **32**, **33**, **34**, and **35** to the outer cover **13** and to the body liner **80**, the absorbent barrier composite **46**, or the leg liner **38**. Preferably the adhesive **71** is applied only to the leg elastics **32**, **33**, **34**, and **35**. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

The crotch elastics **37** and **39** are from about 0.0625 inch (1.6 mm) to about 1 inch (25 mm) wide, more typically from about 0.25 inch (6 mm) to about 1 inch (25 mm), and most typically from about 0.25 inch (6 mm) to about 0.75 inch (18 mm) such as 0.5 inch (13 mm). The crotch elastic **37** and **39** is applied under an elongation of from about 100% to about 300%, more typically under an elongation of from about 150% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The crotch elastics **37** and **39** may comprise threads, strands, ribbons, bands, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the crotch elastic **37** and **39** ranges from about 1 to about 6, more typically from about 2 to about 5, and most typically from about 3 to about 4. Preferably, when the crotch elastics **37** and **39** are threads, 1 to 6 threads are used as the crotch elastics **37** and **39**, and the threads are spaced from about 0.0625 inch (1.6 mm) to about 0.5 inches (13 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable crotch elastics **37** and **39** include threads having a decitex (g/10000m) of from about 470 to about 1200, more typically from about 620 to about 1000, and most typically from about 740 to about 940 for crotch elastics **37** and **39** comprising from about 3 to about 6 threads. Adhesive **71**, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the crotch elastics **37** and **39** to the outer cover **13** and to the absorbent barrier composite **46** or the leg liner **38**. Preferably the adhesive **71** is applied only to the crotch elastics **37** and **39**. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

In one embodiment, to provide a snug fit around the leg openings **28** and **30** and to draw up the sides of the crotch portion **18** to form a cradle structure around the absorbent core **50**, the leg elastics **32**, **33**, **34**, and **35** are applied to the outer cover **13** under an elongation of about 200% to about 250%. The crotch elastics **37** and **39** are sandwiched

between the liquid barrier **48** and the topsheet layer **49** under an elongation of about 200%. Preferably, during the application of the elastics, the front leg elastics **32** and **33** and the back leg elastics **34** and **35** are elongated to a different degree and applied to the outer cover **13**. In one embodiment, the front leg elastics **32** and **33** are elongated less than the back leg elastics **34** and **35**.

In another embodiment providing a snug fit around the leg openings **28** and **30** and drawing the sides of the crotch portion **18** up to form a cradle structure around the absorbent core **50**, the leg elastics **32, 33, 34,** and **35** and the crotch elastics **37** and **39** are applied to the outer cover **13** under an elongation of about 200% to about 250%. Preferably, during the application of the elastics, the front leg elastics **32** and **33** and the back leg elastics **34** and **35** are elongated to a different degree and applied to the outer cover **13**. In one embodiment, the front leg elastics **32** and **33** are elongated less than the back leg elastics **34** and **35**.

In the embodiments having the three segment elastics surrounding each of the leg openings **28** and **30** (the three segment elastics include front leg elastics **32** and **33**, back leg elastics **34** and **35**, and crotch elastics **37** and **39**), the front leg elastics **32** and **33** and the crotch elastics **37** and **39** are elongated less than the back leg elastics **34** and **35**. Preferably, the front leg elastics **32** and **33** and the crotch elastics **37** and **39** are elongated to about 200% and the back leg elastics **34** and **35** are elongated to about 250%. The three segment elastic system and differing tensions allow better fit, less tightness in the groin area, and less bunching of the crotch portion **18** caused by high leg elastic retraction. The back leg elastics **34** and **35** are under higher elongation to help keep the seat of the underpant **12** from creeping up with movement during use and stabilizes the absorbent core **50** from bunching which causes leakage and an uncomfortable fit of the underpant **12**.

In the embodiments having three segments of elastics surrounding each of the leg openings **28** and **30**, the active portions of the crotch elastics **37** and **39** can overlap with the active portions of the leg elastics **32, 33, 34,** and **35** as shown in **Figure 1a** (showing such a configuration with the crotch elastic **39** and leg elastics **32** and **35**). The active portions of the crotch and leg elastics **32, 33, 34, 35, 37,** and **39** (as well as the waist elastic **21** and the waist portion elastic **22**) is defined as the portion of the elastic that

exerts a contractive force on the article **10**.

In **Figure 1a**, another configuration of the three segments of elastics surrounding each of the leg openings **28** and **30** is shown wherein the active portion of the crotch elastic **37** overlaps the active portion of the leg elastic **34** but does not overlap the active portion of the leg elastic **33**. This forms a gap **107** in the elastics surrounding the leg opening **30** in the front body portion **14**. The gap **107** can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

The gap **107** provides a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **32** and **33** and the crotch elastics **37** and **39** during use with certain body shapes and sizes and activities may be reduced. In addition, the front lower body portion **42** is smoothed, providing a more discrete underpant **12**.

Another configuration of the three segments of elastics surrounding each of the leg openings **28** and **30** is shown in **Figure 1b** wherein the active portion of the crotch elastic **39** overlaps the active portion of the leg elastic **32** but does not overlap the active portion of the leg elastic **35**. This forms a gap **111** in the elastics surrounding the leg opening **28** in the back body portion **15**. The gap **111** can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

The gap **111** provides a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **34** and **35** and the crotch elastics **37** and **39** during use with certain body shapes and sizes and activities may be reduced. In addition, the back lower body portion **43** is smoothed, providing a more discrete underpant **12**.

Another configuration of the three segments of elastics surrounding each of the leg openings **28** and **30** is shown in **Figure 1b** wherein the active portion of the crotch elastic **37** does not overlap the active portion of the leg elastics **33** and **34**. This forms gaps **107** and **111** in the elastics surrounding the leg openings **28** and **30** respectively in the front and back body portions **14** and **15** respectively. The gaps **107** and **111** can each range in

size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

The gaps **107** and **111** provide a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **32**, **33**, **34**, and **35** and the crotch elastics **37** and **39** during use with certain body shapes and sizes and activities may be reduced. In addition, the back lower body portion **43** is smoothed, providing a more discrete underpant **12**.

In the embodiment having the two segment elastics surrounding (see **Figure 2a**) the leg openings **28** and **30** (the two segment elastics include front leg elastics **32** and **33**, and back leg elastics **34** and **35**), the front leg elastics **32** and **33** are elongated less than the back leg elastics **34** and **35**. Preferably, the front leg elastics **32** and **33** are elongated to about 200%, and the back leg elastics **34** and **35** are elongated to about 250%. The two segment elastic system and differing tensions allow better fit, less tightness in the groin area, and less bunching of the crotch portion **18** caused by high leg elastic retraction. The back leg elastics **34** and **35** are under higher elongation to help keep the seat of the underpant **12** from creeping up with movement during use and stabilizes the absorbent core **50** from bunching which causes leakage and an uncomfortable fit of the underpant **12**.

Another configuration of the two segments of elastics surrounding each of the leg openings **28** and **30** is shown in **Figure 1c** wherein the active portion of the leg elastic **32** does not overlap the active portion of the leg elastic **35**. This forms a gap **107** in the elastic surrounding the leg opening **28** at the top of the leg opening **28** in the front body portion **14**, back body portion **15**, or in both the front and back body portions **14** and **15**. The gap **107** can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm). The gap **107** provides a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **32**, **33**, **34**, and **35** during use with certain body shapes and sizes and activities may be reduced. In addition, the gap **107** provides a more discrete underpant **12** as "panty lines" are eliminated at the top of the wearer's legs.

In the embodiments having two segments of elastics surrounding each of the leg openings **28** and **30**, the active portions of the leg elastics **32** and **33** can overlap with the active portions of the leg elastics **34** and **35** as shown in **Figure 2a** (showing such a configuration with the leg elastic **32** and leg elastic **35**).

In **Figure 2a**, another configuration of the two segments of elastics surrounding each of the leg openings **28** and **30** is shown wherein the active portion of the leg elastic **33** does not overlap the active portion of the leg elastic **34**. This forms a gap **113** in the elastics surrounding the leg opening **30** in the front body portion **14**. The gap **113** can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

The gap **113** provides a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **32, 33, 34,** and **35** during use with certain body shapes and sizes and activities may be reduced.

Another configuration of the two segments of elastics surrounding each of the leg openings **28** and **30** is shown in **Figure 2a** wherein the active portion of the leg elastic **32** does not overlap the active portion of the leg elastic **35**. This forms a gap **113** in the elastic surrounding the leg opening **28** at the top of the leg opening **28** in the front body portion **14**, back body portion **15**, or in both the front and back body portions **14** and **15**. The gap **113** can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm). The gap **113** provides a more comfortable fit of the underpant **12** in that binding or chafing that may result from the leg elastics **32, 33, 34,** and **35** during use with certain body shapes and sizes and activities may be reduced. In addition, the gap **113** provides a more discrete underpant **12** as "panty lines" are eliminated at the top of the wearer's legs.

In the embodiment having a single segment elastic surrounding (see **Figure 3**) the leg openings **28** and **30** (the single segment elastic include leg elastics **96** and **98**), the leg elastics **96** and **98** are applied under an elongation of from about 100% to about 300%,

more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The waist portion elastic **22** circumferentially surrounding the body portions **14** and **15** of the underpant **12** act independently to conform to the contours of various body types and builds. This provides a smooth, snug, and comfortable fit within a given hip size range. In embodiments having waist elastic **21**, the use of higher elongation, closer spacing, and higher cross-sectional area in the waist elastic **21** than in the waist portion elastic **22**, results in the underpant **12** having a rounded shape and good waist fit across a wide range the waist to hip ratios encountered. The elongation of the waist portion elastic **22** can be different in the front and back body portions **14** and **15**.

Preferably, in the front body portion **14**, the waist portion elastic **22** are spaced apart from the front leg elastics **32** and **33**. The waist portion elastics **22** in the back body portion **15** are spaced apart from the back leg elastics **34** and **35**. The distance between the waist portion elastic **22** and the leg elastics **32, 33, 34,** and **35** may range from about 0.125 inch (3 mm) to about 3 inches (76 mm), more typically from about 0.25 inch (6 mm) to about 2 inches (51 mm), and more typically from about 0.25 inch (6 mm) to about 1.5 inches (38 mm). The spacing in the front body portions **14** and **15** are not required to be the same size. However, the waist portion elastic **22** in either or both of the front and back body portions may be adjoin the front or back leg elastics **32, 33, 34,** and **35** respectively. In embodiments where waist elastic **21** are present, it is preferable that the waist portion elastic **22** are spaced apart from the waist elastic **21** and the leg elastics **32, 33, 34,** and **35**.

However, the waist portion elastic **22** in either or both of the front and back body portions may adjoin either or both the waist elastic **21** and the leg elastics **32, 33, 34,** and **35** wherein the waist portion elastic **22** adjoin at least a portion of the leg elastics **32, 33, 34,** and **35**. In a underpant **12** which is sized to comfortably fit a hip range from about 36 inches (914 mm) to about 45 inches (1143 mm), the waist portion elastic **22** are about 4 inches (102 mm) wide in the front body portion **14** and about 6.25 inches (159 mm) wide in the back body portion **15**. The waist portion elastic **22** may be spaced from about 0.0625 inch (1.6 mm) to about 0.5 inch (13 mm) apart. Preferably, the waist portion elastic **22** are spaced from 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm) apart. Most

preferably, the waist portion elastic **22** are spaced about 0.125 inch (3 mm) apart.

The absorbent barrier composite **46** which extends up the front and/or back body portions **14** and **15** toward the waist opening **20** is conformed to the wearer's body by the force exerted by the waist portion elastic **22**. The transition from the front and back lower body portions **42** and **43** to the front and back upper body portions **40** and **41** is thus smoothed.

In embodiments having waist elastic **21**, it is desirable that the waist elastic **21** are under a greater tension per unit width than the waist portion elastic **22** in the upper body portions **40** and **41** to provide the snug waist fit over the range of waist to hip ratios of the various body shapes. In the preferred embodiment, the tension on the waist elastic **21** is coordinated with the tension of the waist portion elastic **22** to form a snug fit about the waist opening **20** while providing a smooth transition from the upper body portions **40** and **41** to the front and back waist edge portions **44** and **45**. However, the tensions and the LYCRA® counts of the waist elastic **21** and the waist portion elastic **22** can be different.

In the front and back body portions **14** and **15**, the leg liner **38**, the waist liner **26**, and /or the topsheet layer **49** may be expanded to cover the interior of the body portions **14** and **15**. In another embodiment, the leg liner **38**, the waist liner **26**, and/or the topsheet layer **49** may exclude the center crotch portion **18** which is covered by the application of the absorbent barrier composite **46**. In the body portions **14** and **15** where the absorbent barrier composite **46** overlaps the liner **80**, the composite **46** is applied on top of any liner **80** present so as to contact the wearer. However, the overlapping portion of the absorbent barrier composite **46** may be sandwiched between the outer cover **13** and the body liner **80**.

For embodiments having waist portion elastic **22**, leg elastics **32**, **33**, **34**, and **35**, and crotch elastics **37** and **39**, the following ranges for the tensions of the elastics **22**, **32**, **33**, **34**, **35**, **37**, and **39** are provided in TABLE III below.

TABLE III

	Acceptable Range		More Acceptable Range		Most Acceptable Range	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Waist Elastic 22	10 grams	150 grams	30 grams	100 grams	45 grams	75 grams
Leg Elastics 32, 33, 34, and 35	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams
Crotch Elastics 37 and 39	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams

For embodiments having waist elastic **21**, waist portion elastic **22**, leg elastics **32**, **33**, **34**, and **35**, and crotch elastics **37** and **39**, the following ranges for the tensions of the elastics **21**, **22**, **32**, **33**, **34**, **35**, **37**, and **39** are provided in TABLE IV below.

TABLE IV

	Acceptable Range		More Acceptable Range		Most Acceptable Range	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Waist Elastic 21	30 grams	300 grams	50 grams	200 grams	100 grams	175 grams
Waist Elastic 22	10 grams	150 grams	20 grams	100 grams	40 grams	60 grams
Leg Elastics 32, 33, 34, and 35	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams
Crotch Elastics 37 and 39	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams

The tensions of the waist elastic **21**, waist portion elastic **22**, crotch elastics **37** and **39**, and leg elastics **32**, **33**, **34**, and **35** were determined as follows. Samples having the dimensions of 10 mm wide and 51 mm in length were tested for each of the elastics **21**, **22**, **32**, **33**, **34**, and **35**. The tensions stated in TABLE III and TABLE IV are given in grams per a 10 mm width. If the size of the sample being tested varies from a 10 mm width, the values must be normalized to a 10 mm width. The tensions were measured during the first cycle extension at 100 percent elongation at room temperature and humidity.

The side seams **64** and **70** may be made on the inside or outside of the underpant **12** or formed flat against the underpant **12** to give a more finished look to the underpant **12** and to prevent the side seams **64** and **70** from showing through clothing. Optionally, the lateral edges **60**, **62**, **66** and **68** of the front and back body portions are not overlapped but are formed flat and extend out laterally. The side seams **64** and **70** should be minimal in width while providing sufficient strength to be pulled up and down many times over a 24 hour wear period without tearing or breaking. Suitable side seams and

seals are described in U.S. Patents 4,610,681 issued September 9, 1986, to Strohbeen et at., 4,641,381 issued February 10, 1987 to Heran et al., and 4,646,362 issued March 3, 1987 to Heran et al. which are incorporated herein by reference. In addition, the side seams **64** and **70** maybe refastenable. Various means of securing the disposable underpant **12** around the wearer include mechanical type fasteners. These include buttons and button holes, snaps, buckles, clasps, hooks and loops, end extensions, tabs, adhesive tapes and the like which are designed or adapted to interlock or engage some type of a complimentary device or the outer cover of the garment. In addition, elasticized fasteners are also used in assuring better fit of the disposable underpant **12**.

The side seams **64** and **70**, respectively, of the outer cover **13** are sealed by means known in the art, such as ultrasonic bonding, stitching heat/pressure bonding or adhesive bonding. The maximum seam strength attainable is dependent upon materials used, bond pattern, bond width, and process settings of dwell time, power, and pressure. Suitable side seams typically utilize ultrasonic bonding to achieve a seam strength such that the side seams **64** and **70** do not tear or open during use.

The side seams **64** and **70** may have an unbonded portion outboard of the bonded area to provide for a soft edge to each of the side seams **64** and **70**. This unbonded portion can ranged from about 0 to about 13 mm in width, more preferably from about 1 to about 6 mm in width and most preferably from about 2 to about 3 mm in width. Alternatively, the entire seam width (bonded portion plus unbonded portion) may be less than about 0.6 inch (15 mm). If the seam is trimmed or cut close to the outer edge of the bond area, a sharp edge is produced along the seam edge which can catch on clothes or be irritating to the wearer's skin.

Having thus described the invention in full detail, it will be readily apparent that various changes and modifications may be made without departing from the spirit of the invention. All such changes and modification are contemplated as being within the scope of the present invention, as defined by the following claims.

We Claim:

1. A disposable underpant defining an initial expanded shape having longitudinal and transverse axes, a front section, a back section, said front section and said back section being generally oppositely disposed on said longitudinal axis and a central section disposed between said front section and said back section, and each said section having a length along the longitudinal axis of one third of the length of said underpant comprising:

a) an outer cover having a front body portion and a back body portion connected by a crotch portion, said front and back body portions connected together to form a waist opening and two leg openings; and,

b) an absorbent barrier composite associated within at least said crotch portion having a liquid impervious layer, a pervious layer, and a generally rectangular absorbent core having a front end edge and a back end edge positioned between said liquid impervious layer and a pervious layer,

wherein said absorbent core is disposed within said sections such that the length of said absorbent core in the back section divided by the length of said absorbent core in said front section and said central section is less than 0.155 and said length of said absorbent core in said front section is greater than said length of absorbent core in said back section.

2. The disposable underpant of Claim 1, wherein said front body portion further comprises a front waist edge portion and said back body portion further comprises a back waist edge portion.

3. The disposable underpant of Claim 1, wherein said outer cover further comprises leg elastic positioned around each of said leg openings to form a gather around each said leg opening, and waist portion elastic positioned around said front and back body portions to form a gather of said front and back body portions.

4. The disposable underpant of Claim 2, wherein said outer cover further comprises leg elastic positioned around each of said leg openings to form a gather around each said

leg opening, and waist portion elastic positioned around said front and back body portions to form a gather of said front and back body portions.

5. The disposable underpant of Claim 2, wherein said front end edge of said absorbent core is disposed from about 7 inches to about 3 inches from said front waist opening and said back end edge of said absorbent core is disposed from about 4 inches to about 10 inches from said waist opening.

6. The disposable underpant of Claim 5, wherein said absorbent core is positioned symmetrically relative to said longitudinal axis.

7. The disposable underpant of Claim 6, wherein said absorbent core is positioned symmetrically relative to said longitudinal axis.

8. The disposable underpant of Claim 1, wherein said length of said absorbent core is from about 15 inches to about 21 inches.

9. The disposable underpant of Claim 2, wherein said length of said absorbent core is from about 15 inches to about 21 inches.

10. The disposable underpant of Claim 1, wherein said outer cover further comprises waist elastic positioned around said waist opening to form a gather around said waist opening.

11. The disposable underpant of Claim 2, wherein said outer cover further comprises waist elastic positioned around said waist opening to form a gather around said waist opening.

12. A disposable underpant defining an initial expanded shape having longitudinal and transverse axes, a front section, a back section, said front section and said back section being generally oppositely disposed on said longitudinal axis and a central section disposed between said front section and said back section, and each said section having a length along the longitudinal axis of one third of the length of said underpant comprising:

a) an outer cover having a front body portion and a back body portion connected by a crotch portion, said front and back body portions connected together to form a waist opening and two leg openings; and,

b) an absorbent barrier composite associated within at least said crotch portion having a liquid impervious layer, a pervious layer, and a generally rectangular absorbent core having a front end edge and a back end edge positioned between said liquid impervious layer and a pervious layer; and,

c) said outer cover further comprises leg elastic positioned around each of said leg openings to form a gather around each said leg opening, and waist portion elastic positioned around said front and back body portions to form a gather of said front and back body portions,

wherein said absorbent core is disposed within said sections such that the length of said absorbent core in the back section divided by the length of said absorbent core in said front section and said central section is less than 0.155 and said length of said absorbent core in said front section is greater than said length of absorbent core in said back section.

13. The disposable underpant of Claim 12, wherein said front body portion further comprises a front waist edge portion and said back body portion further comprises a back waist edge portion.

14. The disposable underpant of Claim 13, wherein said front end edge of said absorbent core is disposed from about 7 inches to about 3 inches from said front waist opening and said back end edge of said absorbent core is disposed from about 4 inches to about 10 inches from said waist opening.

15. The disposable underpant of Claim 12, wherein said absorbent core is positioned symmetrically relative to said longitudinal axis.

16. The disposable underpant of Claim 12, wherein said length of said absorbent core is from about 15 inches to about 21 inches.

17. The disposable underpant of Claim 13, wherein said length of said absorbent core is from about 15 inches to about 21 inches.

18. The disposable underpant of Claim 12, wherein said outer cover further comprises waist elastic positioned around said waist opening to form a gather around said waist opening.

19. The disposable underpant of Claim 13, wherein said outer cover further comprises waist elastic positioned around said waist opening to form a gather around said waist opening.

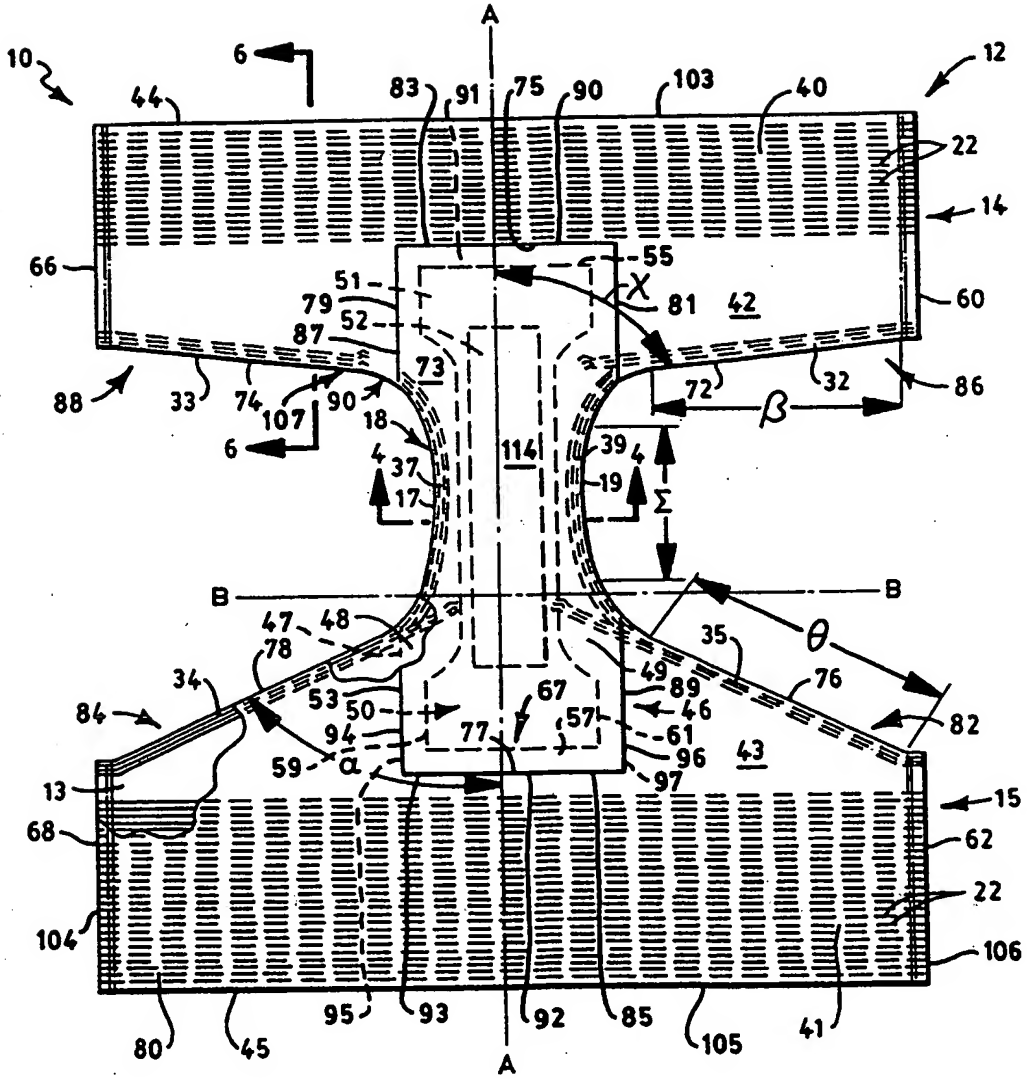
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FIG. 1a

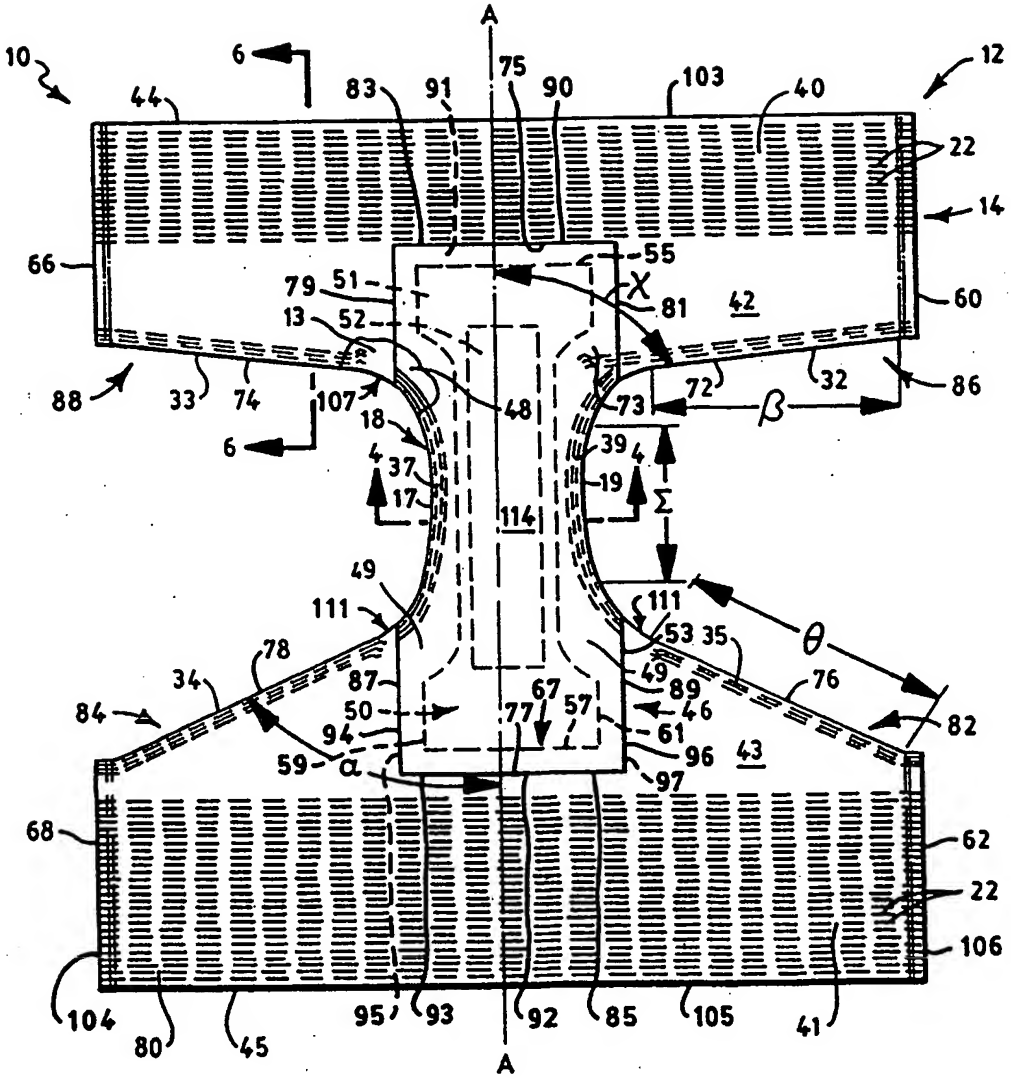
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FIG. 1b

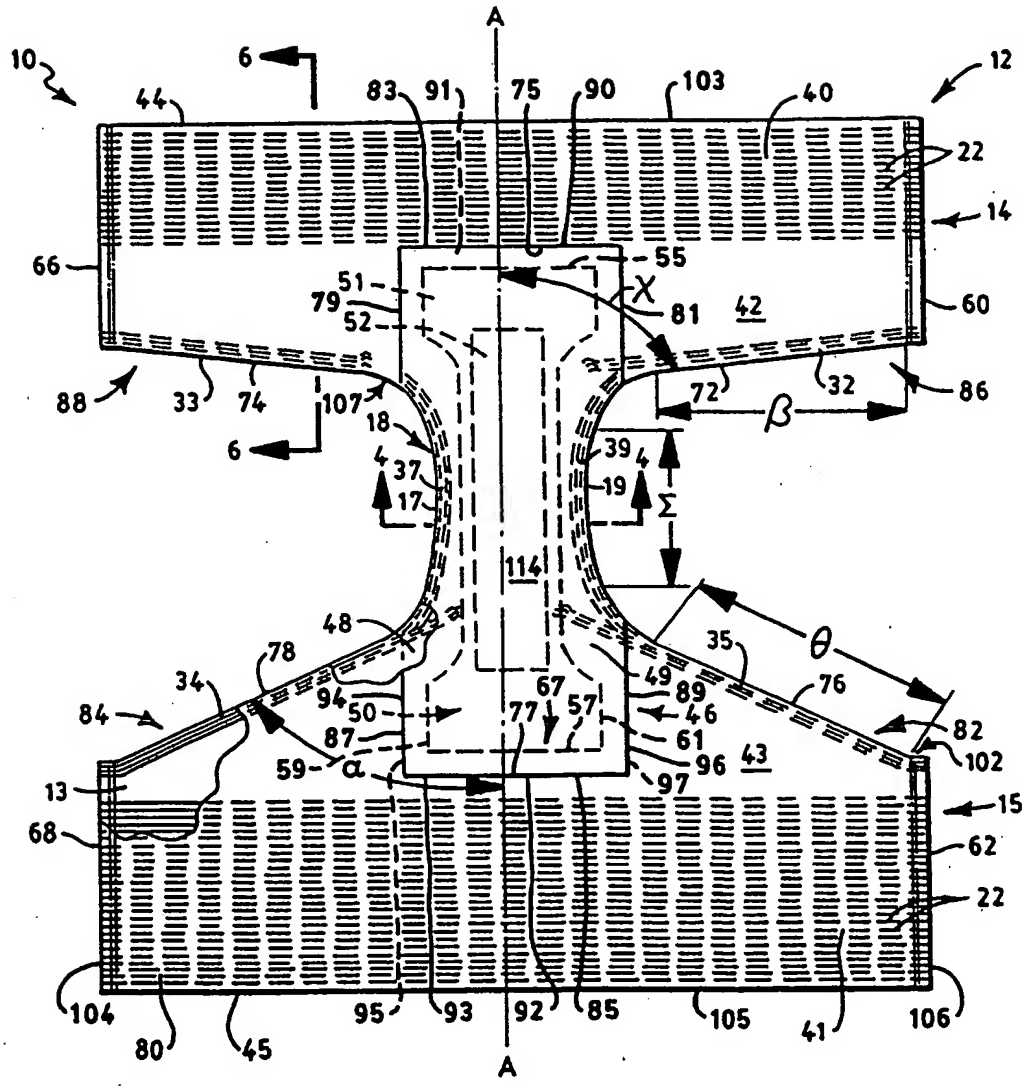
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FIG. 1c

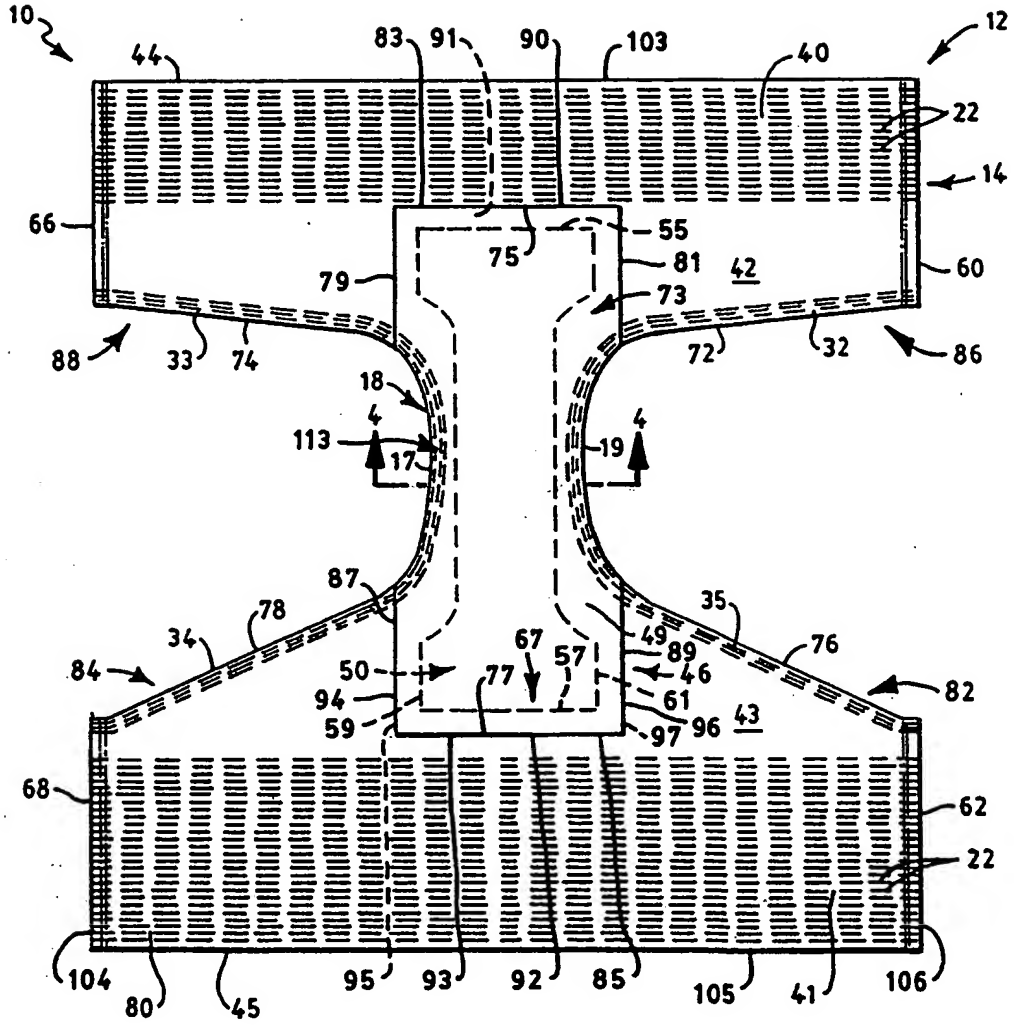
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FIG. 2a

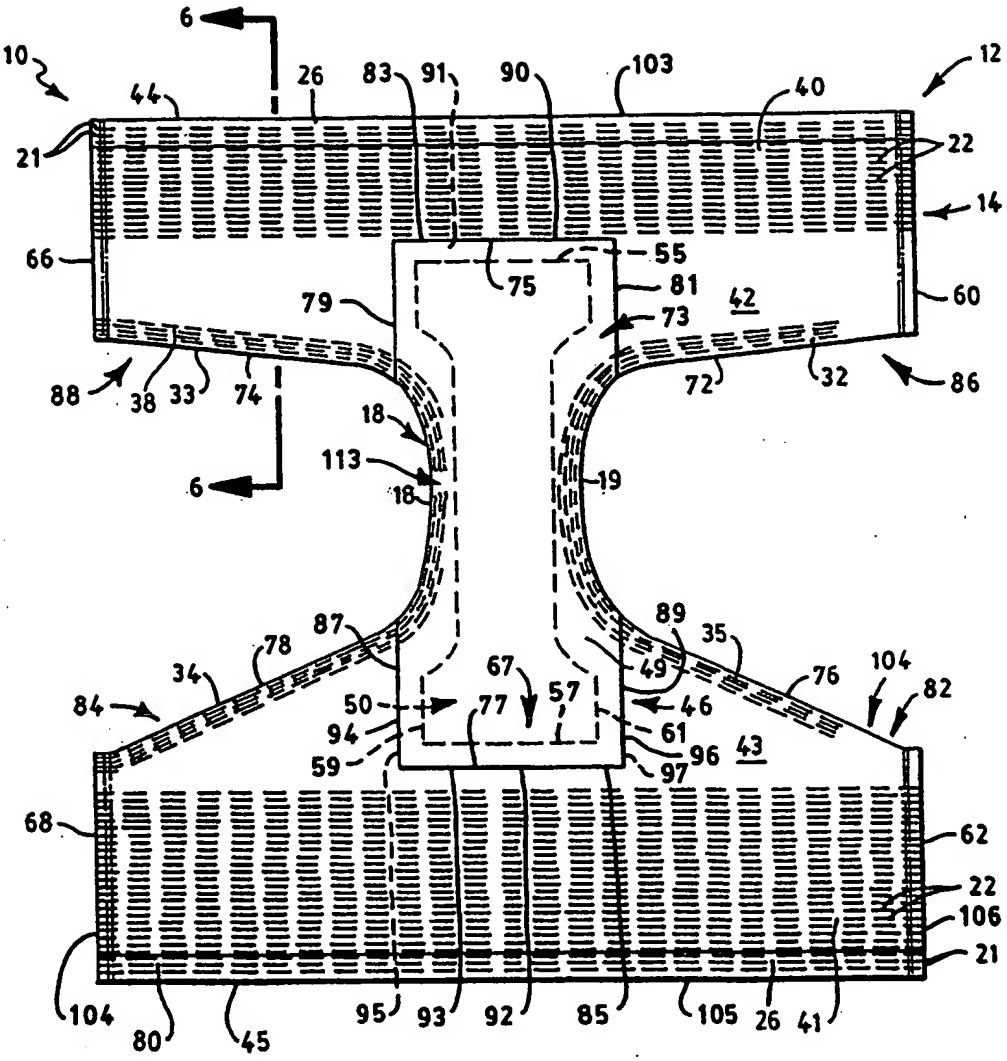
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FIG. 2b

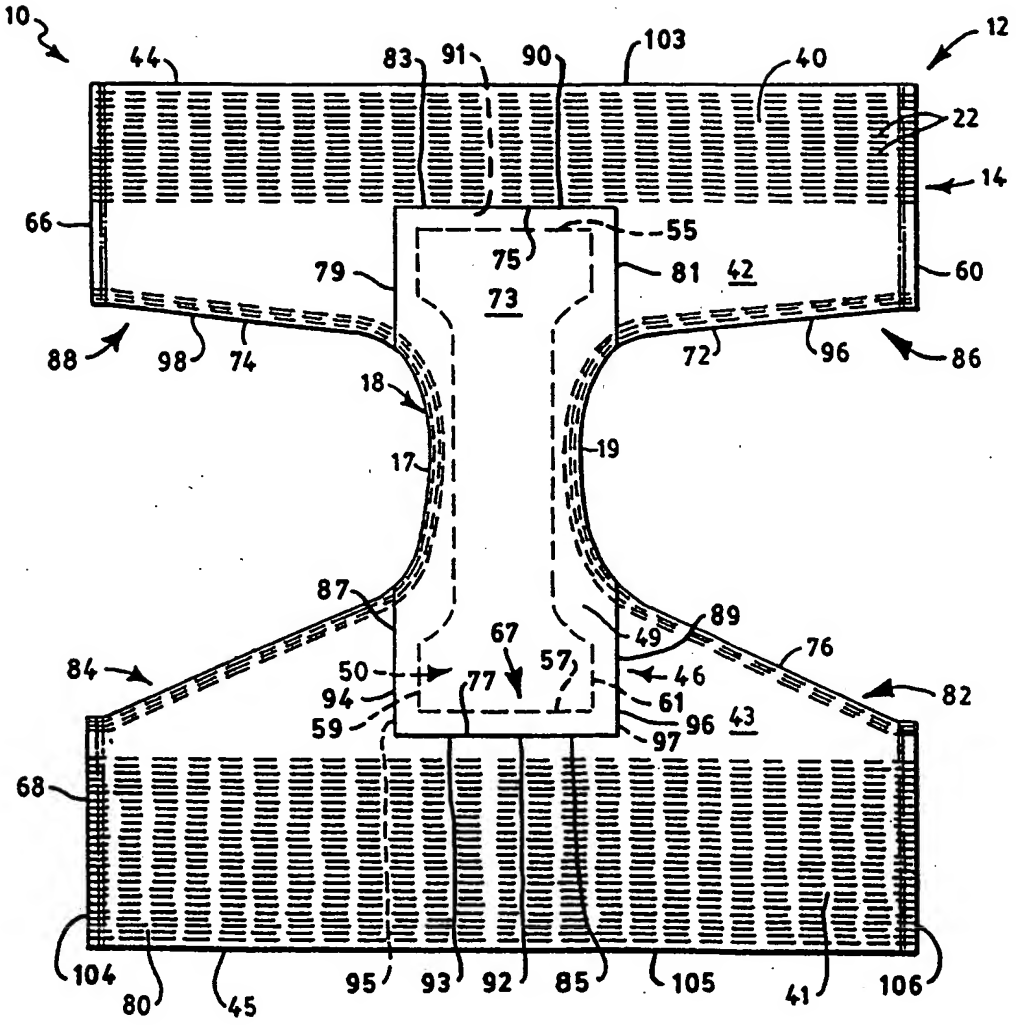
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FIG. 3

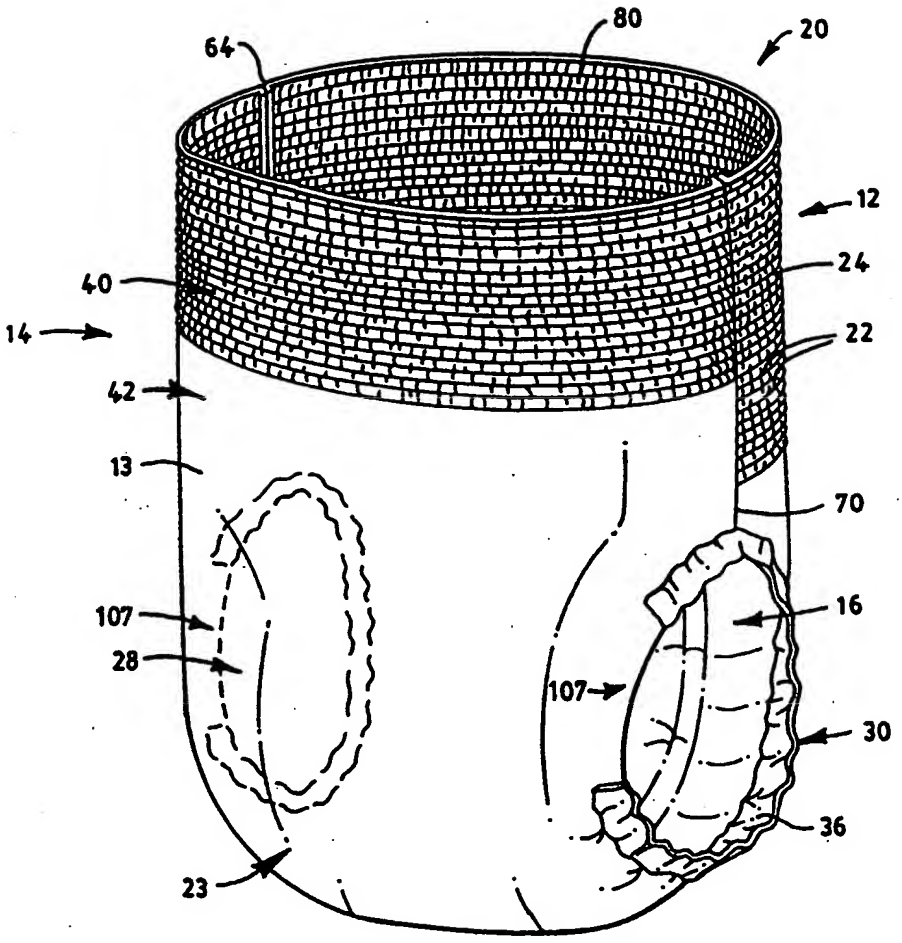

FIG. 4

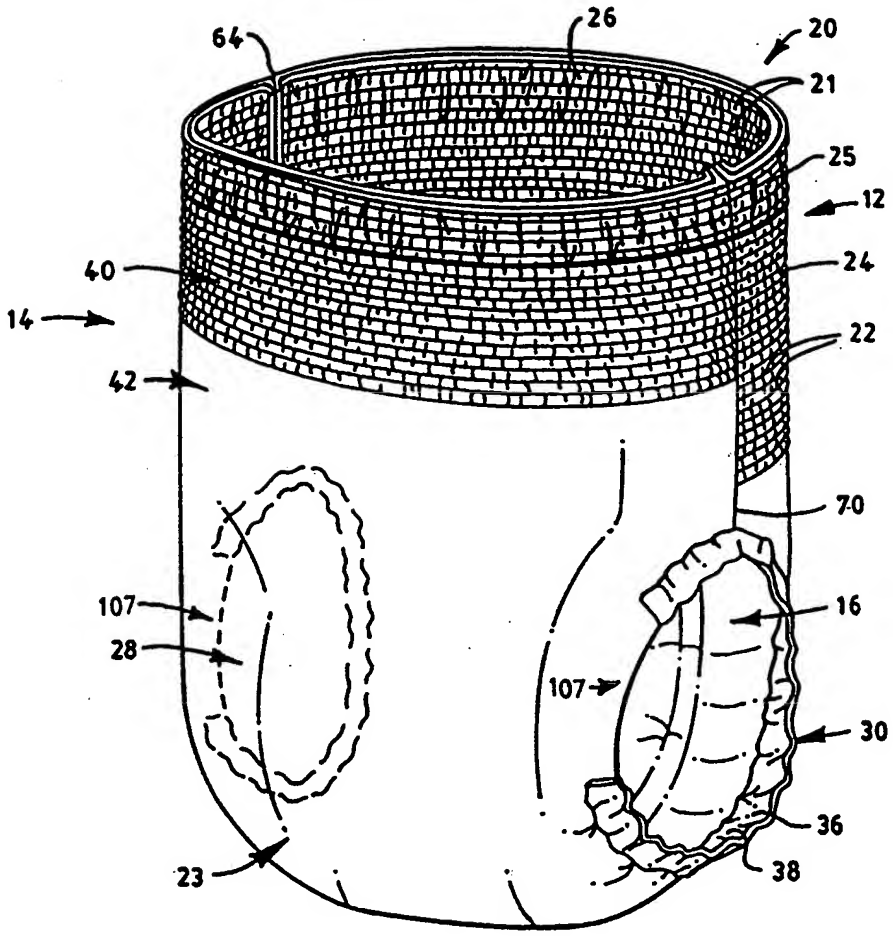

FIG. 5

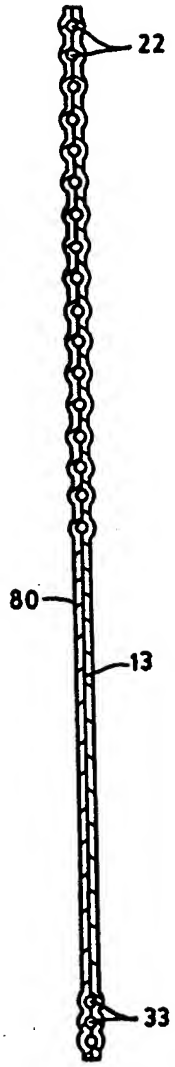

FIG. 6

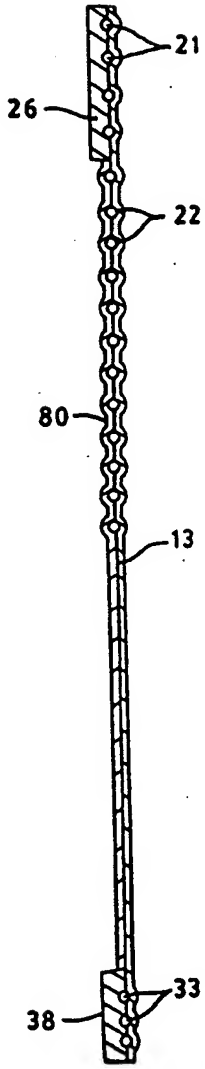

FIG. 7

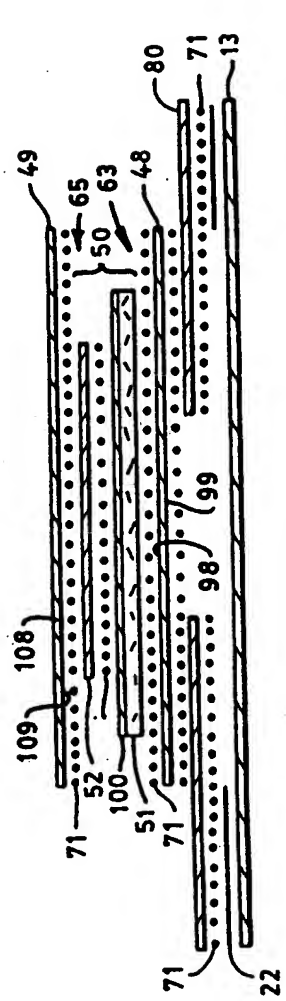
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FIG.8

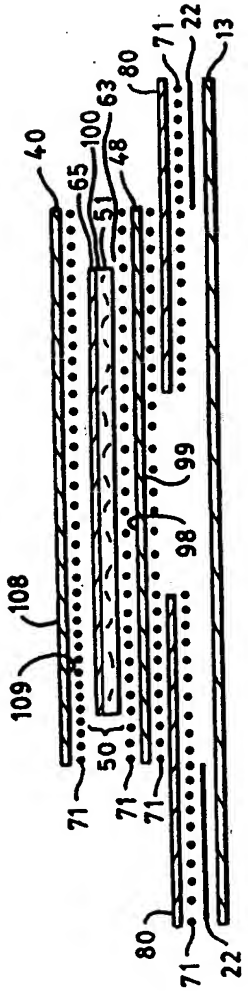
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FIG. 9

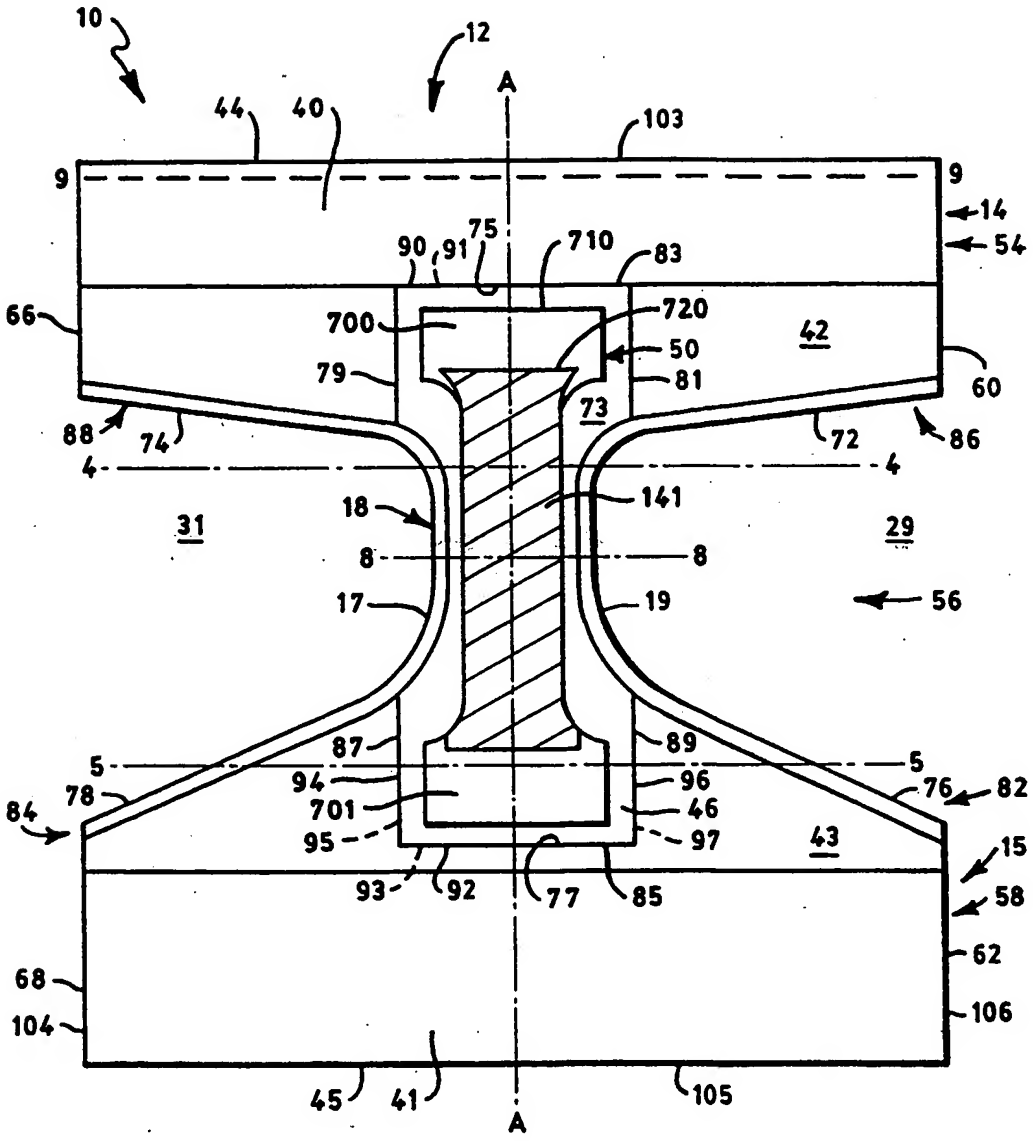
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FIG. 10

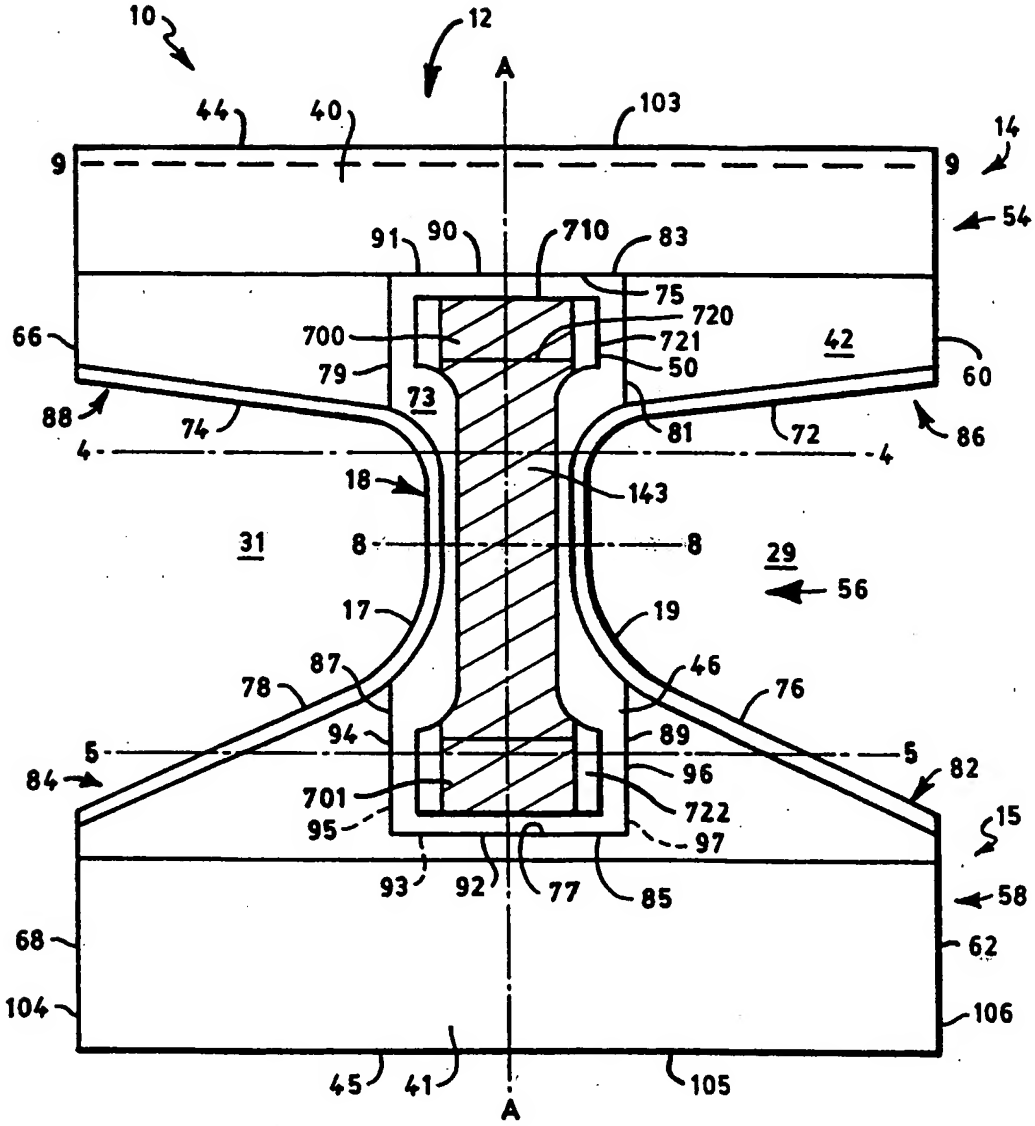
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FIG. 11

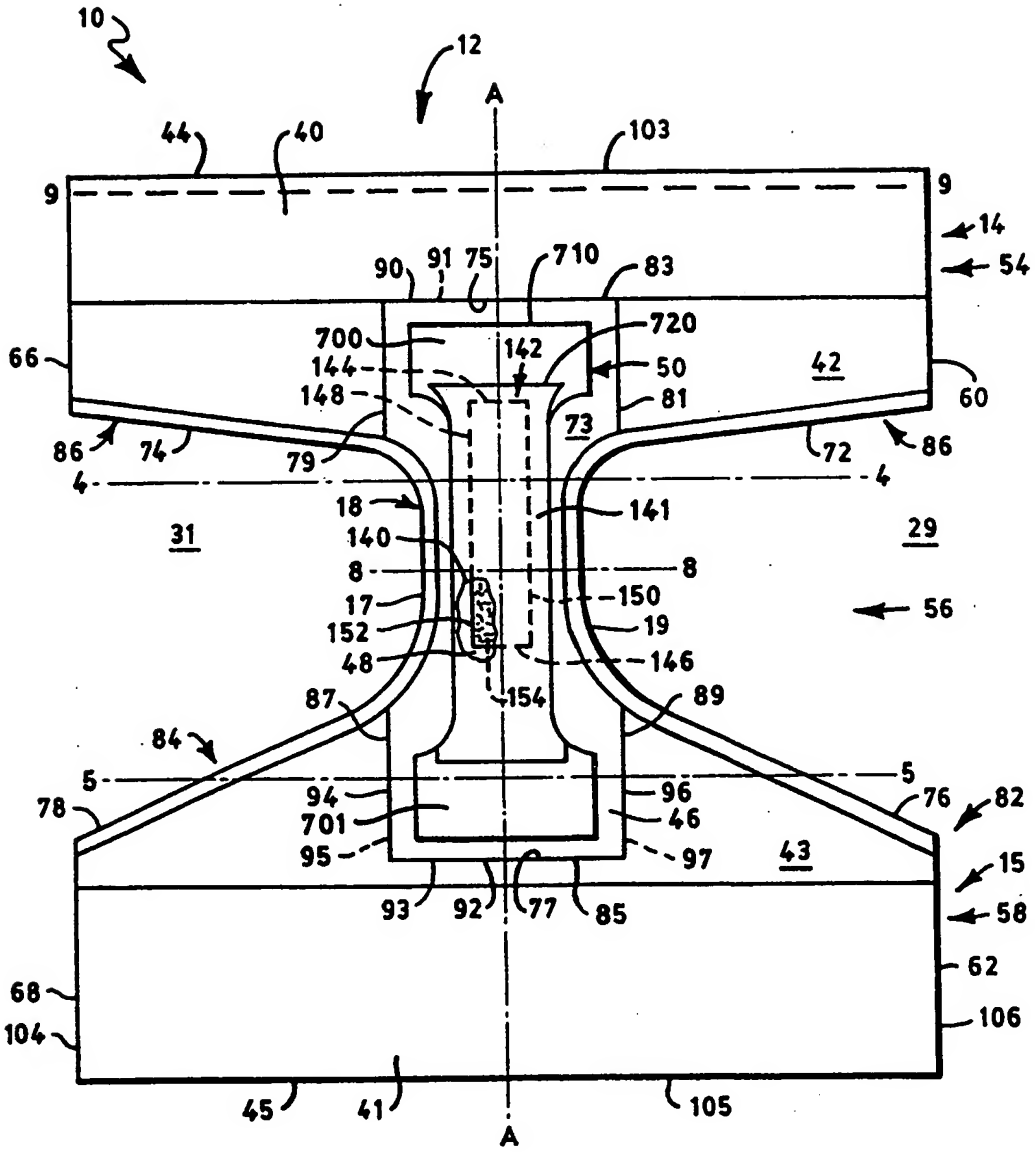
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FIG. 12

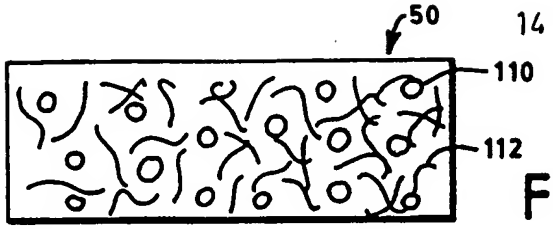

FIG. 13a

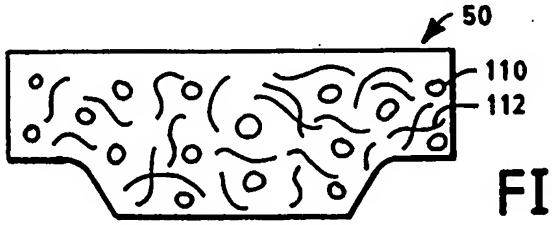

FIG. 13b

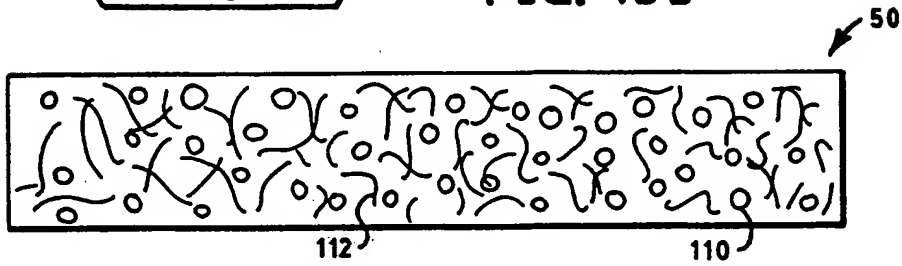

FIG. 14

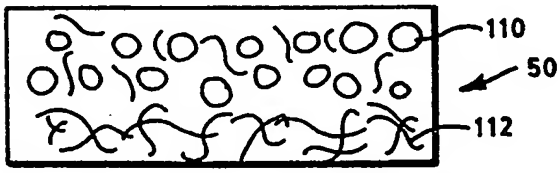

FIG. 15a

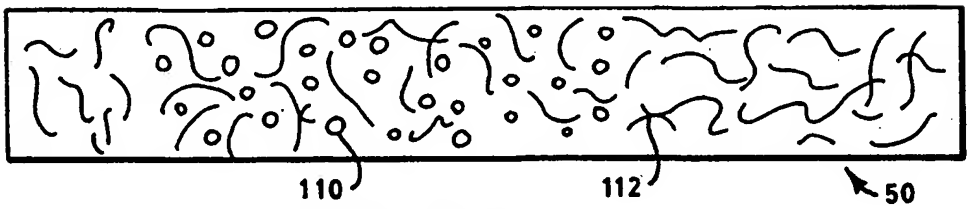

FIG. 15b

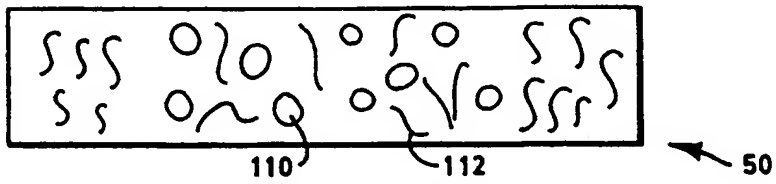

FIG. 15c

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/15442

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F13/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 14453 A (PROCTER & GAMBLE) 1 June 1995 (1995-06-01) page 10, line 28 -page 11, line 11; figures	1-19
X	WO 95 22951 A (PROCTER & GAMBLE) 31 August 1995 (1995-08-31) claims; figures	1-19
X	GB 2 294 865 A (MOELNLYCKE AB) 15 May 1996 (1996-05-15) page 3, line 3 -page 11, line 14; figure 1	1-19

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 1999	18/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl. Fax: (+31–70) 340–3016	Douskas, K

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Information on patent family members

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